ADMINISTRATIVE DRAFT

KAKA'AKO AREAWIDE TRAFFIC STUDY

Submitted by:

FEHR & PEERS
201 Santa Monica Blvd., Suite 500
Santa Monica, CA 90401

December 2009

FEHR & PEERS
TRANSPORTATION CONSULTANTS

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Submitted to:

City of Honolulu
PB Americas, Inc.

Submitted by:

FEHR & PEERS
201 Santa Monica Blvd., Suite 500
Santa Monica, California 90401
(310) 458-9916

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1. EXECUTIVE SUMMARY

As a supplement to the Honolulu High Capacity Transit Corridor Project (HHCTCP) Draft Environmental Impact Study (DEIS), the Kaka'ako Areawide Traffic study was conducted for the City and County of Honolulu to assess regional and local access to future guideway transit stations and the surrounding high-density commercial and residential development in the Kaka'ako-Makiki areas of O'ahu, Hawaii. The study identifies the regional freeway bottlenecks and causes of local traffic congestion in the study area and presents an areawide transportation improvement program that aids mobility.

The study area encompasses the H-1 freeway from Pali Highway to just east of Kapahulu Avenue (approximately four miles). For local circulation, the study boundary is defined by Wilder Avenue and Lunalilo Street on the north, Punchbowl Street on the west, Ala Wai Canal and Kapi'olani Boulevard on the east, and the Pacific Ocean. The area currently supports approximately 7,000 residents and 23,400 jobs.

Between year 2000 and 2030, the study area is envisioned for a significant change in land use makeup from primarily industrial and commercial uses to a high-density residential and commercial mix. The population and employment are expected to increase considerably to almost 33,000 residents and 33,800 jobs. Existing traffic congestion on the regional H-1 freeway and major arterials has significantly affected the circulation and quality of life of residents and visitors in the study area. Severe congestion at the freeway interchanges with gridlock conditions were observed at all ramp access intersections, resulting in increased neighborhood cut-through traffic.

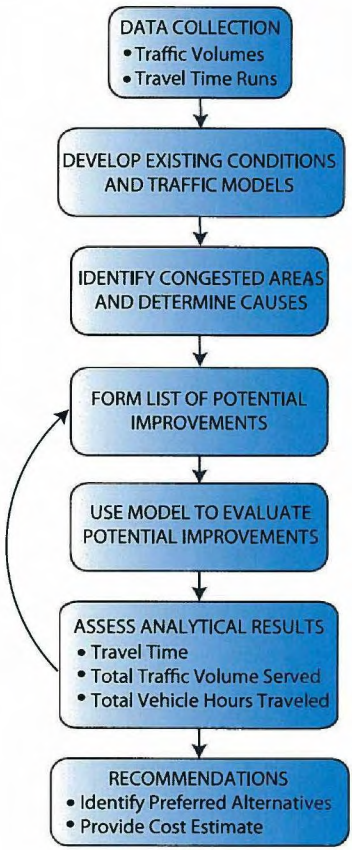
As a provision for future population growth and construction of the guideway transit corridor, this study makes specific recommendations for roadway improvements in this study area, including widening or modification of the freeway ramps, re-configuration of the intersections, and modification to traffic control devices. The plan recommends 20 roadway improvement projects in the contexts of both regional access (12 projects) and local circulation near future guideway stations (8 projects). Highlights of the plan are:

- New circulation roadways near the future Kaka'ako guideway transit station and the Ward neighborhood
- Add a new left-hand off-ramp[1] from H-1 to Vineyard Boulevard, with reconfiguration to existing Vineyard Boulevard flyover
- Re-opening access from the Lunalilo on-ramp to the H-1 Freeway during the AM peak period, and provision of two lanes on the Lunalilo Street on-ramp, which would merge into a single lane before merging with H-1 after the Vineyard Boulevard off-ramp
- Widening the H-1 eastbound mainline from the Pali Highway on-ramp to the Kinau Street off-ramp by one lane to allow two lanes entering from Pali Highway to H-1
- Widening H-1 eastbound off-ramp at Kinau Street from one to two lanes
- Shifting H-1 westbound off-ramp at Lunalilo Street to lengthen the weaving section with Punahou Street

1 A left-hand off-ramp allows vehicles to exit the freeway from the travel lane closest to the center median, as opposed to exiting the freeway from the right-hand side curb lane.

- Peak hour parking restriction on one side of Kinau Street between Ward Avenue and Pi'ikoi Street for additional eastbound travel lane
- Converting Pensacola Street mauka of Lunalilo Street to just north of Wilder Avenue to two-way operations (with one lane northbound and two lanes southbound)
- Improving access to H-1 Freeway ramps by modifying lane geometry at three intersections: Lunalilo Street/Pensacola Street, Pi'ikoi Street/Kinau Street/Lunalilo Street, Pensacola Street/Wilder Avenue/Pi'ikoi Street
- Improving access to future guideway station area by modifying lane geometry and/or control devices at these intersections: Ward Avenue/Ala Moana, Ward Avenue/Queen Street, Kamakee Street/Ala Moana Boulevard, Cooke Street/Halekauwila Street, Kona Street/Ke'eaumoku Street, Kona Street/ Kaheka Street, Kapi'olani Boulevard/Ward Avenue.

Figure S-1 is the study approach for the Kaka'ako study. Figures S-2A-C illustrate the locations of the recommended regional and station area roadway improvements, respectively. Table S-1 provides project description and order-of-magnitude cost estimates.



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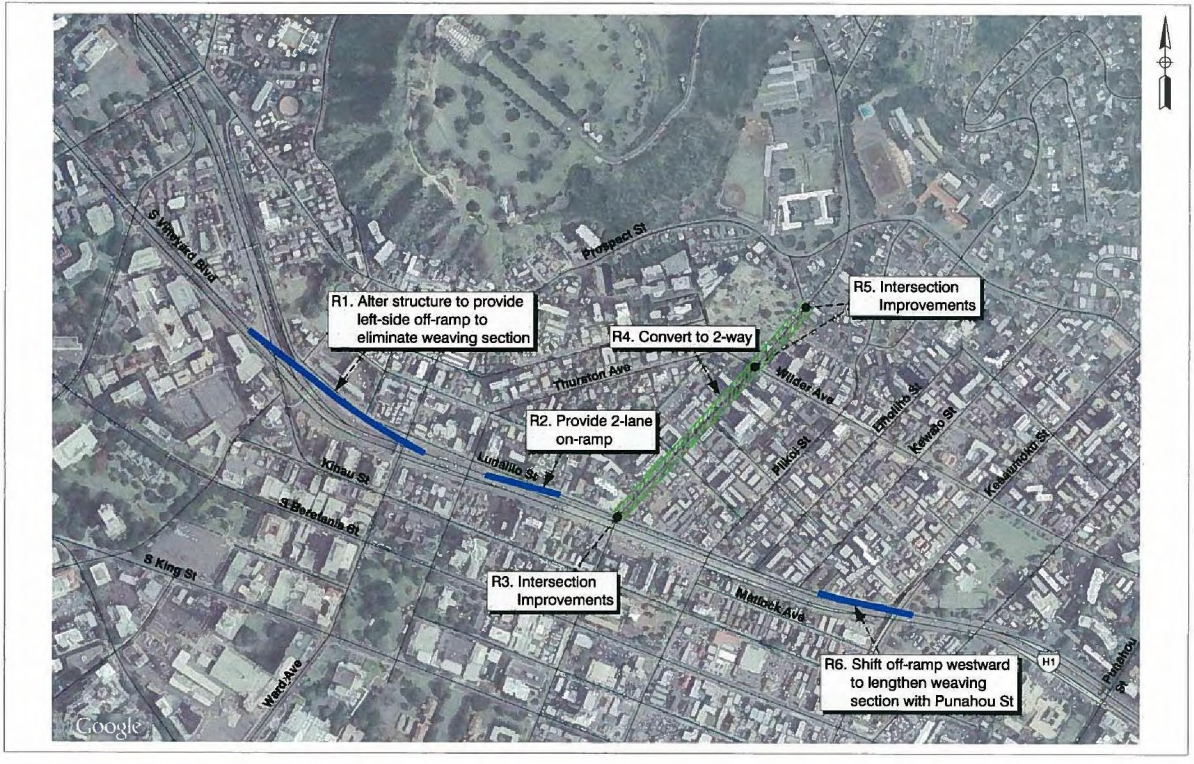
STUDY APPROACH FOR THE KAKA'AKO STUDY

FIGURE 13



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RECOMMENDED ROADWAY IMPROVEMENTS
REGIONAL ACCESS TO H-1 WESTBOUND

FIGURE S-2A

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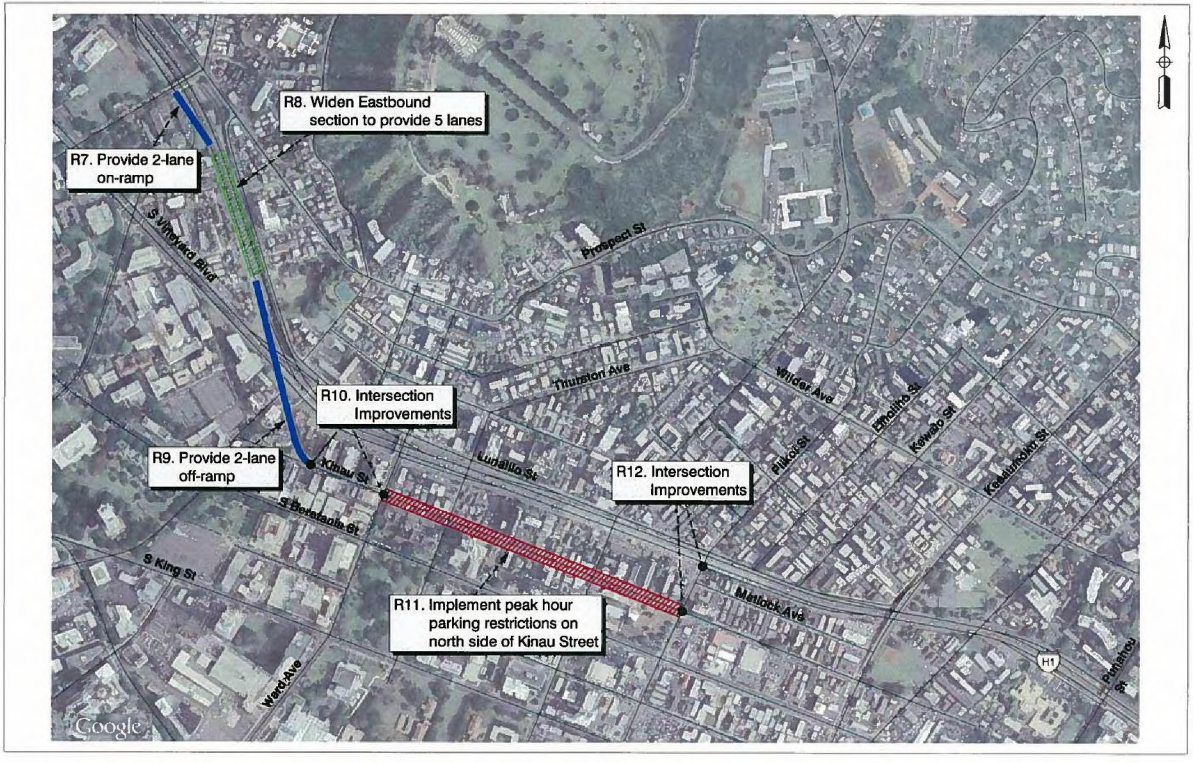

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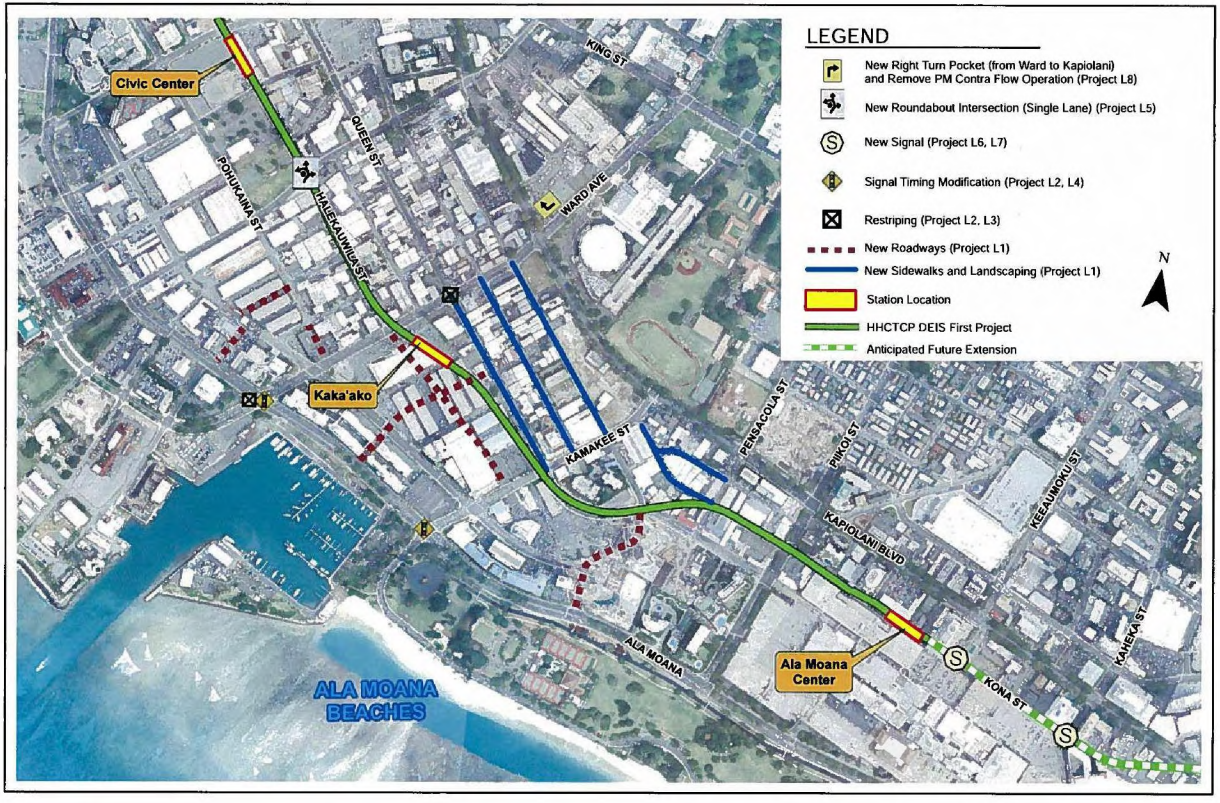
RECOMMENDED ROADWAY IMPROVEMENTS
REGIONAL ACCESS TO H-1 EASTBOUND

FIGURE S-2B



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LOCAL CIRCULATION IMPROVEMENT PLAN
NEAR FUTURE GUIDEWAY TRANSIT STATIONS
FIGURE S-2C

TABLE S-1

RECOMMENDED REGIONAL AND LOCAL ROADWAY IMPROVEMENT PLAN FOR THE KAKA'AKO AREAWIDE TRAFFIC STUDY

Types	Project #	Facility	Project Description	Cost Estimates (Millions of Year 2008 Dollar) [a]
Regional Roadway Improvements to Enhance H-1 Freeway Access	R 1	H-1 Westbound Left Hand Side Off-Ramp at Vineyard Boulevard	(1) Alter structure to provide a two-lane left-side off-ramp onto Vineyard Boulevard. The existing 3-lane approach segment would gain an "exit only" lane on the left and the left lane would have an option to exit onto Vineyard Boulevard. Vehicles entering H-1 from the 2-lane on-ramp at Lunalilo Street would merge into one-lane when the lane is added on the left and would merge with H-1 after the off-ramp and therefore not be able to access the Vineyard Boulevard off-ramp. (2) Additional right-of-way may be required to accommodate the column placement on the mauka side of the H-1 Freeway at Lunalilo Street and Ward Avenue.	$119.0
	R2	H-1 Westbound Lunalilo Street On-Ramp	If Project R1 is implemented, provide two lanes on the Lunalilo Street on-ramp which would merge into a single lane before merging with H-1 after the Vineyard Boulevard off-ramp. Vehicles would be allowed to access H-1 but not Vineyard Boulevard.	$9.0
	R3	Lunalilo Street and Pensacola Street Intersection	Provide one left-turn lane, a shared through/left-turn lane, a through lane, and a free right-turn lane on the westbound approach (split phasing) and a through lane, a shared through/right-turn lane, and a right-turn lane with no right-turn on red on the southbound approach (split phasing) to the Lunalilo Street and Pensacola Street intersection.	$0.7
	R4	Pensacola Street from Pi'ikoi Street (north of Wilder Avenue) to Lunalilo Street	(1) Provide one-lane in the northbound direction and two lanes in the southbound direction on Pensacola Street from Pi'ikoi Street to Lunalilo Street. (2) Provide signage and signals to indicate two-way operation. Reorient the southbound facing parking along the east curb of Pensacola Street to a northbound direction.	$0.2
	R5	Pensacola Street and Wilder Avenue/Pi'ikoi Street intersections	(1) Provide the following lane configurations at the Wilder Avenue and Pensacola Street intersection: Northbound - all shared (permitted phasing). Southbound - shared through/left-turn lane and shared through/right-turn lane (permitted phasing). Eastbound - shared through/left-turn lane and a right-turn lane (split phasing). Westbound - one left-turn lane, a shared through/left-turn lane, and a right-turn lane (split phasing). (2) Provide an uncontrolled through lane in the northbound and southbound directions and stop-controlled left- and right-turn lanes on the westbound approach to the Pi'ikoi Street and Pensacola Street intersection. (3) Restrict parking in the non-functional westbound right-turn lane to provide a westbound right-turn lane.	$0.5
	R6	H-1 Westbound off-ramp at Lunalilo Street	Shift off-ramp westward closer to Liholiho Street to lengthen weaving section with Punahou Street.	$4.9
	R7	H-1 Eastbound On-Ramp at Pali Highway	(1) Widen on-ramp to provide two lanes onto H-1. The existing 3-lane auxiliary segment would need to be restriped to provide one trap lane onto the H-1 on-ramp, one trap lane onto the Punchbowl Street off-ramp, and one lane with access to both. (2) A physical barrier would be provided to restrict H-1 off-ramp traffic to the Punchbowl Street off-ramp.	$4.5
	R8	H-1 Eastbound mainline from Pali Highway On-Ramp to Kinau Street Off-Ramp (weave section)	Widen section of H-1 to 5 lanes to provide additional capacity and to accommodate the new two-lane on-ramp from Pali Highway.	$12.5
	R9	H-1 Eastbound Off-Ramp at Kinau Street	Widen off-ramp to provide two lanes from H-1. This improvement is also needed to accommodate the additional H-1 lane from Project R8.	$10.1
	R10	H-1 Eastbound off-ramp/Kinau Street and Kinau Street/Ward Avenue Intersections	(1) Install a physical barrier to eliminate the stop-controlled eastbound through movement while providing side-street stop-control on the existing uncontrolled eastbound through lane. (2) Restripe the eastbound approach to the Kinau Street/Ward Avenue intersection to provide a shared through/left-turn lane, two through lanes, and a right-turn lane.	$0.1
	R11	Kinau Street between Ward Avenue and Pi'ikoi Street	Implement peak hour parking restrictions and "Anti-Gridlock Zone" signs on one side of Kinau Street between Ward Avenue and Pi'ikoi Street to provide 3 lanes in the eastbound direction.	$0.1
	R12	Pi'ikoi Street and Kinau Street/Lunalilo Street Intersections	(1) Provide two left-turn lanes, two through lanes, and a free right-turn lane to the H-1 eastbound on-ramp on the northbound approach to the Pi'ikoi Street and Lunalilo Street intersection (split phasing). Provide proper signage to direct motorists wishing to make a left-turn onto Pensacola Street to use the left-most left-turn lane, motorists wishing to make a right-turn onto Pensacola Street to use the right-most left-turn lane, and vehicles wishing to access H-1 to use either left-turn lane. Also provide two through lanes and a free right-turn lane onto Pi'ikoi Street on the westbound approach (split phasing). (2) Remove approximately 3 parking spaces (for a total ~ 150' of red curb) from the south curb of the east leg of the intersection of Pi'ikoi St & Kinau Ave in order to allow a safe merging of the eastbound through vehicles due to curb side parking. (The peak hour parking restriction does not apply east of Pi'ikoi St.)	$0.7

TABLE S-1

RECOMMENDED REGIONAL AND LOCAL ROADWAY IMPROVEMENT PLAN FOR THE KAKA'AKO AREAWIDE TRAFFIC STUDY

Types	Project #	Facility	Project Description	Cost Estimates (Millions of Year 2008 Dollar) [a]
Local Circulation Improvements in the Vicinity of Future Guideway Stations	L1	Circulatory roadways in Ward neighborhood [b]	(1) Improve the landscape and install sidewalks on Queen Street, Kawaiahao Street and Waimanu Street between Ward Avenue and Kamakee Street	$1.6
			(2) Improve the landscape and install sidewalks on Hopaka Street and Kona Street from Kamakee Street to Pi'ikoi Street	$3.0
			(3) Extend Halekauwila Street from Ward Avenue to Kamakee Street to provide direct access from Ward neighborhood to the Civic Center area	$17.8
			(4) Extension of Cummins Street from Queen Street to Ala Moana Boulevard	$15.9
			(5) Extension of Pohukaina Street from Kamani Street to Ward Avenue	$5.1
			(6) Extension of Ahui Street from Pohukaina Street to Ala Moana Boulevard	$11.4
			(7) Extention of Queen Lane from Ala Moana Boulevard to Waimanu Street	$16.5
			subtotal (1) thru (7)	$71.2
	L2	Ward Avenue/Ala Moana intersection	Restripe the southbound approach of Ward Avenue from one shared thru/right lane, one shared thru-left lane and one exclusive left turn lane to one exclusive right turn lane, one shared thru/left lane and one exclusive left turn lane. Modify the signal timing and phasing to increase green time for the northbound approach.	$0.02
	L3	Ward Avenue/Queen Street intersection	(1) Restripe both approaches of Queen Street from a single lane to a right turn lane and a shared thru-left turn lane.	$0.04
			(2) Remove parking on the mauka side of Queen Street east of Ward Avenue (approximately five 90-degree parking spaces) and on the makai side of Queen Street west of Ward Avenue (approximately 2 curb parking spaces).	
	L4	Kamakee Street/Ala Moana Boulevard intersection	Modify existing signal timing plan to allocate more green time from Ala Moana Boulevard to Kamakee Street.	$0.004
	L5	Cooke Street/Halekauwila Street intersection	Reconfigure the stop controlled intersection to a single lane roundabout with landscaped central island and splitter island. Right-of-way acquisition would be required	$2.0
	L6	Kona Street/Ke'eaumoku Street intersection	Proposed improvement: Install new signals for traffic and pedestrians. [c]	$0.7
	L7	Kona Street/Kaheka Street intersection	Install new signals for traffic and pedestrians.	$0.7
	L8	Kapi'olani Boulevard/Ward Avenue intersection	(1) Widen the makai bound approach of Ward Avenue to add a right turn lane to facilitate the right turn vehicles from Ward Avenue to Kapi'olani Ewa bound.	$2.2
			(2) Remove the coned contra flow operation at this intersection during the P.M. peak hour (i.e., current P.M. contra flow operation on Kapi'olani Boulevard ends between Cooke Street and South Street. With this improvement, contra flow would end between Kamakee Street and Ward Avenue). Left turn from Kapi'olani Boulevard to Ward Avenue would remain restricted.	
				$239.12

Note:

[a] These estimates do not include costs associated with right-of-way acquisition.

[b] The concept improvements were developed based on review of two documents: (1) *Draft Mauka Area Plan - Kaka'ako Hawaii Community Development District, Honolulu, Hawaii, Hawaii Community Development Authority (HCDA), May 2007, and (2) Ward Neighborhood Master Plan, General Growth Properties, Inc., (GGP), April 16, 2008*

[c] Signalization of Kona Street and Ke'eaumoku Street intersection would be consistent with the traffic mitigation measure proposed at this location in the *Honolulu Capacity Transit Corridor Project - Draft Environmental Impact Statement/Section 4(f) Evaluation, November 2008, City and County of Honolulu*.

Source: Fehr & Peers, 2009.

2. INTRODUCTION

BACKGROUND

With the anticipated construction of the proposed Honolulu High Capacity Transit Corridor Project (HHCTCP), the proposed Kaka'ako Station will provide opportunities for developing an integrated multi-modal environment and transit-oriented development for the Kaka'ako-Makiki communities and Ward neighborhoods (Figure 1). The area surrounding the proposed Kaka'ako station has a high level of urban density with a mix of apartments and commercial properties. However, existing traffic congestion on the regional State Highway 1 (H-1) freeway and major arterials has significantly affected the quality of life of the Kaka'ako communities and impedes multi-modal access to the proposed guideway transit stations in the study area, including Kaka'ako Station, Civic Center Station, and Ala Moana Station.

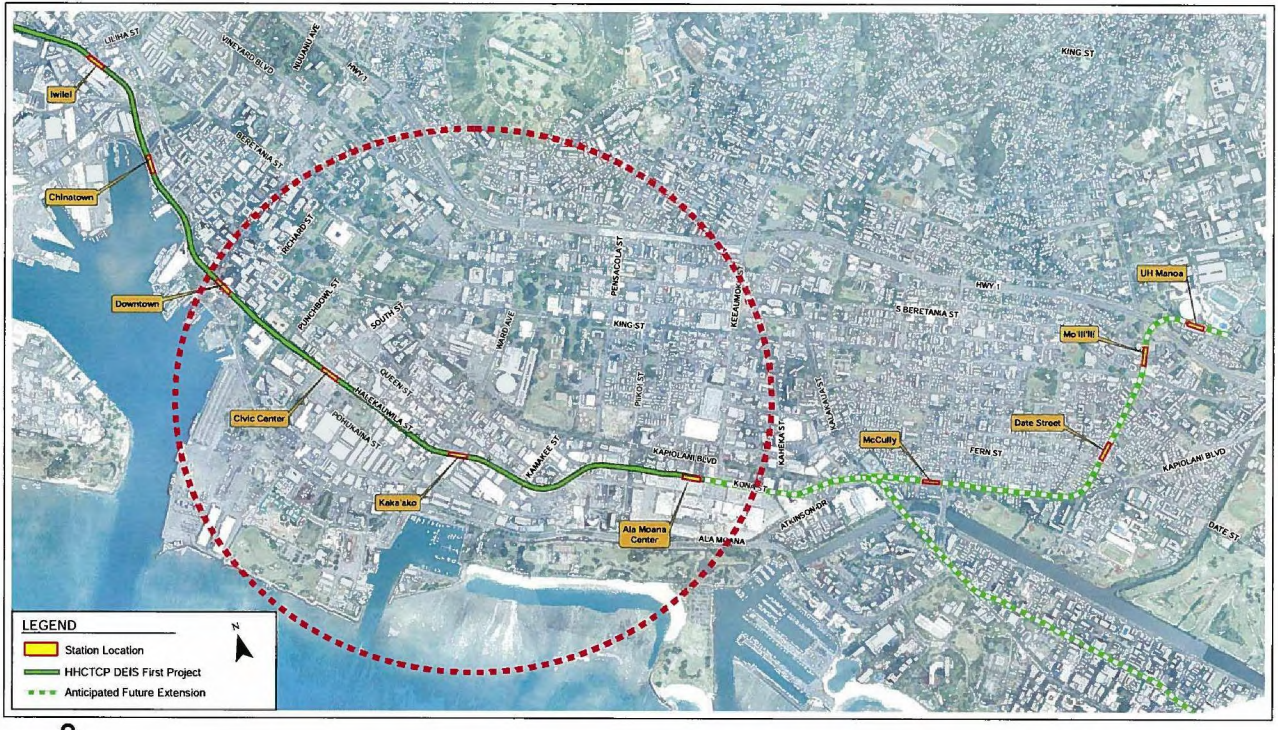
PURPOSE OF STUDY

The Kaka'ako Areawide Traffic Study was conducted to identify the regional freeway bottlenecks and causes of local traffic congestion in the study area and presents an areawide transportation improvement program that aids mobility. A key element of the study is the operations of the H-1 Freeway. The goals of the Kaka'ako Study include:

- To detail and quantify the potential traffic implications associated with the alignment and station area activity of the HHCTCP as discussed and mitigated in the Draft Environmental Impact Statement (DEIS).
- To assess the need for additional local access and circulation system improvements in and around the high-density commercial and residential development in the Kaka'ako study area as a result of traffic from the HHCTCP stations and other area projects.
- To evaluate the regional access to the high-density commercial and residential development in the study area and identify additional highway improvements or modifications to aid mobility in response to traffic generated in the vicinity of the HHCTCP stations and other area projects.

The study's assessments were made by developing a sub-area model from the base year 2007 and future 2030 travel demand models used in the DEIS for HHCTCP, developing local area traffic forecasts based on this sub-area model, and then identifying roadway deficiencies. A VISUM travel demand forecasting model was created and used to forecast local traffic demand in much greater detail than possible using the HHCTCP model. The model characteristics were then converted to develop data for use in the study area traffic micro-simulation model. A VISSIM traffic simulation model was then used to identify existing and future roadway deficiencies and improvement opportunities in the study area. The forecasting model simulations were then used to develop improvement projects for the study area and to evaluate their effectiveness individually.

The product of this study is the preparation of an areawide improvement program for the study area. This step used the VISUM/VISSIM model package as the base to identify existing and future transportation bottlenecks and improvement opportunities for the H-1 corridor and the arterials and intersections in the vicinity of the future Civic Center and Kaka'ako Stations.



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KAKA'AKO PROJECT STUDY AREA
FIGURE 1

ORGANIZATION OF THIS REPORT

This report is organized into seven sections:

- Section 1 – Executive Summary
- Section 2 – Introduction
- Section 3 – Study Approach and Methodology
- Section 4 – Existing Conditions
- Section 5 – Future Conditions
- Section 6 – Recommended Improvements
- Section 7 – Conclusions

Two technical appendices are also attached, including Appendix A, which documents the development of the traffic demand forecasting model and micro-simulation model for this study, and Appendix B, which documents the assessment of the effect of potential reversal of Pi'ikoi-Pensacola Couplet under 2030 conditions.

3. STUDY APPROACH AND METHODOLOGY

ANALYSIS TOOLS AND DATA COLLECTION

The H-1 Freeway and the local arterials in the study area operate as a system with congestion and delays affecting both upstream and downstream operations. A systematic approach was used for the operations analysis. The study uses a combination of data collection and modeling tools including VISUM and VISSIM, with travel demand information from the O'ahu island-wide travel demand model developed by the O'ahu Metropolitan Planning Organization (O'ahuMPO). The O'ahuMPO model was developed for *O'ahu Regional Transportation Plan 2030* (ORTP) (O'ahuMPO, 2007) and for *Draft Environmental Impact Statement/Section 4(f) Evaluation - Honolulu High Capacity Transit Corridor Project* (City and County of Honolulu, November 2008).

This section identifies the methodology used to analyze the existing and future base conditions with and without improvements in the Kaka'ako study area.

Analysis Tools

The primary tools used in the traffic forecasting process are the island-wide regional travel demand forecasting model developed for the island of O'ahu by the O'ahuMPO and the VISUM modeling software package for the study area. The O'ahuMPO island-wide model is a newly expanded and calibrated four-step model. A sub-area from the regional travel model was extracted using VISUM and was used to develop and facilitate a more detailed estimation of travel patterns on a turning movement level of detail. VISUM allows the process to capture the local scale distributional effects of roadway improvements made to the H-1 freeway and arterials in the study area. Of particular interest were the major improvements to the interchanges and the shift in traffic patterns associated with these improvements.

The project area experiences severe congestion at the freeway interchanges, with gridlock conditions on most ramp access intersections, resulting in increased neighborhood cut-through traffic. Travel patterns in the study area are sensitive to changes in roadway capacity, signal operations, and traffic demand. The demand-based VISUM model was supplemented with the traffic operations tool VISSIM. The VISSIM traffic micro-simulation model was used to conduct network-wide evaluations of traffic operations including corridor travel time estimates, focused analyses of freeway ramp access, and intersection queuing/delay. Field observations and on-road surveys were conducted for the major corridors during the peak periods to calibrate the VISSIM micro-simulation model. The results from the VISUM and VISSIM model runs were used to identify existing and future roadway deficiencies and improvement opportunities.

Data Collection

New traffic counts and lane geometries were collected at 50 intersections and 35 H-1 Freeway facilities (segments and ramps) in September 2008 for this analysis. October 2007 count data collected at 23 intersections for the traffic analysis of the proposed guideway transit station area in the DEIS were also used. Two freeway mainline counts were collected on the H-1 Freeway immediately west of the Pali Highway Interchange and immediately east of the Kapahulu Avenue Interchange to capture the traffic entering and exiting the study area.

With the volumes on both ends of the study area and the segment count data for traffic entering and exiting all the ramps, traffic volumes were estimated for each freeway mainline section between ramps. The AM and PM peak period traffic counts were balanced and used to calibrate and validate the sub-area VISUM model. Lane geometries were used to develop individual turning movement capacities at all 73 study intersections for use in the trip assignment process. Posted speed limits, travel speeds and travel time on H-1 and major arterials during the peak hours were also collected.

DEVELOPMENT OF ROADWAY IMPROVEMENTS

The traffic circulation issues in the study area stem from over-saturated conditions, design of the freeway weave sections, one-way circulation and geometric constraints. This project lends itself to building on this effort to improve not only transportation elements but also to aid community development.

The study researched existing and future conditions in the study area and changes in population, travel behavior and traffic congestion, supplemented by a review of studies for the State and City agency or communities, including:

- *Draft Mauka Area Plan - Kaka'ako Hawaii Community Development District, Honolulu, Hawaii* (Hawaii Community Development Authority [HCDA], May 2007)
- *Ward Neighborhood Master Plan* (General Growth Properties, Inc. [GGP], April 16, 2008)
- *Interstate Route H-1: Lunalilo On-Ramp & Off-Ramp Improvements Study* (R.M. Towill Corporation, July 2001)
- *Waikiki Regional Traffic Impact Plan – Summary Report* (Kaku Associates, Inc., December 1995)

The calibrated and validated existing micro-simulation model was used to generate performance measures consistent with Highway Capacity Manual (HCM) (Transportation Research Board, 2000). The validated VISSIM model will serve as the basis for future conditions models. Supplemented by field observations, the existing and future base 2030 VISSIM models were used to develop potential H-1 Freeway and local arterial improvements. The roadway facility elements of the alternatives considered include:

- Construction of new circulation roadways to improve community access
- Widening, relocation and/or re-alignment of the ramps in the study area
- Widening and/or re-configuration of the intersections in the study area
- Widening and/or re-alignment of various study arterial corridor segments
- Conversion of one-way to two-way operations on various arterial segments

The measures of effectiveness (MOEs) used to evaluate proposed roadway improvements include:

- System-wide performance, including number of vehicles served, vehicle miles traveled (VMT), vehicle hours traveled (VHT), vehicle hours of delay (VHD), speed, and vehicle hours of delay per mile
- Travel time on the freeway and major arterial corridors
- Freeway ramp operations (volume-to-capacity [V/C] ratio estimates)
- Intersection level-of-service (LOS)
- Cost and benefit estimates of project alternatives

4. EXISTING CONDITIONS

The Kaka'ako-Makiki areawide traffic study area covers the H-1 freeway from Pali Highway to just east of Kapahulu Avenue (approximately four miles). For local circulation, the study boundary is defined by Wilder Avenue and Lunalilo Street on the north, Punchbowl Street on the west, Ala Wai Canal and Kapi'olani Boulevard on the east, and the Pacific Ocean. One focus of this study is regional and local access to the Kaka'ako Community District2 and the adjacent Ala Moana-Mo'ili'li and Makiki-Manoa communities. The Kaka'ako-Makiki area currently supports more than 7,000 residents and 23,400 jobs.

REGIONAL ACCESS TO KAKA'AKO

Regional access to the study area is provided primarily by H-1, supplemented by a combination of State Routes and local arterials.

Traffic Conditions on H-1 Freeway

H-1 extends along an east-west path throughout the study area, approximately one-half mile north of the core Kaka'ako area. Three travel lanes are provided in each direction on the H-1 mainline, with access ramps every half-mile to one mile. One to two auxiliary lanes are also provided at a few locations3 for a weave and merge section.

According to the speed survey results for the H-1 Freeway (Figure 2), major bottlenecks were observed in both directions of H-1 approaching the study area, at the Liliha Interchange on the west end and the Kapi'olani Interchange on the east end during both AM and PM peak periods. Congestion at the Liliha Interchange was a result of commuter traffic heading to Downtown Honolulu and the school district north of H-1. Congestion at the Kapi'olani Interchange was primarily a result of the crossing movement between traffic entering H-1 from 6th Street and traffic leaving for the flyover ramp at Kapi'olani Boulevard. During the morning peak hour (6:30 to 7:30 AM), approximately 6,000 vehicles were observed to travel in either direction on H-1 in the vicinity of Pali Highway. Koko Head of Kapahulu Avenue, approximately 5,900 vehicles were observed to enter the study area on Ewa-bound H-1, while 5,100 vehicles were traveling to the Windward side.

In the core H-1 study corridor from Nuuanu Bridge to Kapahulu Avenue during the AM peak period, congested conditions were observed on sections of the H-1 Freeway from Nuuanu Bridge to Ke'eaumoku Street in the Koko Head-bound direction and from the Kapi'olani Interchange to Punahou Street in the Ewa-bound direction. The hot spots on H-1 during the AM peak hour include:

- Eastbound lanes between the on-ramp at Pali Highway and off-ramp at Punchbowl Street
- Eastbound merge section between Vineyard Boulevard and Ward Avenue
- Eastbound off-ramp at Kinau Street

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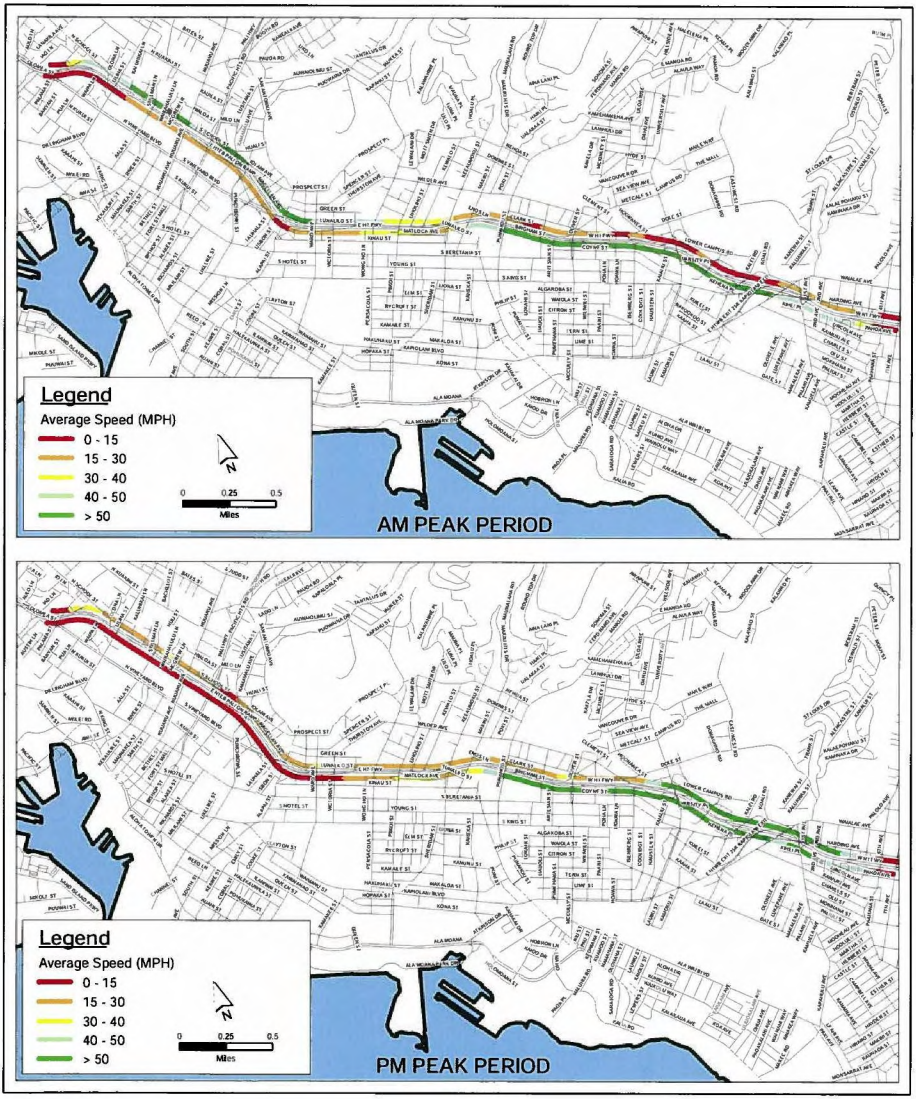
2 *Draft Mauka Area Plan - Kaka'ako Hawaii Community Development District* (Honolulu, Hawaii, Hawaii Community Development Authority (HCDA), May 2007). *"The Kaka'ako Community District Area is comprised by two sub-areas: Mauka Area and Makai Area. The Mauka Area covers an approximately 450-acres area and is bordered by Pi'ikoi Street, Ala Moana Boulevard, Punchbowl Street and King Street. The Makai Area includes approximately 220-acres area and is defined by Ala Moana Boulevard, Ala Moana Regional Park, and Honolulu Harbor."*

3 Auxiliary lanes are provided on the H-1 Freeway Ewa bound between the Lunalilo on-ramp west of Pensacola Street and Vineyard exit, between the Punahou Street on-ramp and the Ke'eaumoku Street off-ramp, between University Avenue and Wilder Avenue, and H-1 Freeway Koko Head bound between the Liliha Street on-ramp and the Pali Highway off-ramp, between the Pali makai-bound on-ramp and the Kinau off-ramp, and the Pi'ikoi on-ramp to the Punahou Street off-ramp.



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H-1 FREEWAY
AM AND PM PEAK HOUR AVERAGE TRAVEL SPEED
FIGURE 2

- Eastbound off-ramp at Punahou Street
- Westbound merge section between Wai'alae Avenue on-ramp and University off-ramp
- Westbound weave section between the on-ramp at University and off-ramp at Wilder Avenue
- Westbound on-ramp at Alexander Street and Metcalf Street
- Westbound weave section between the H-1 off-ramp at Lunalilo Street and local traffic on Lunalilo Street under the Ke'eaumoku Bridge

With these hot spots, the average corridor travel time on H-1 from Nuuanu Bridge to just east of Kapi'olani Interchange (about four miles) was approximately 10 to 11 minutes in the eastbound direction and 13 to 15 minutes westbound.

During the PM peak period, traffic congestion is generally worse than the AM conditions. In the afternoon peak hour (5:00 to 6:00 PM), approximately 6,100 vehicles were traveling on H-1 eastbound at Pali Highway, while almost 6,600 vehicles were traveling in the opposite direction. East of the Kapi'olani Interchange, approximately 5,400 vehicles are entering the study area on Ewa-bound H-1, while approximately 8,704 vehicles were traveling on H-1 eastbound exiting the study area. Stop-and-go conditions were observed on the eastbound lanes beginning at the Liliha Interchange to east of Ward Avenue, with a slightly better flow from Ward Avenue to Punahou Street. East of Punahou Street, the H-1 traffic queue dissipated and operated at almost free flow conditions (50 miles per hour) until the 6th Street off-ramp. Westbound, congested conditions began at the University Interchange and extended all the way to the Nuuanu Stream. Several hot spots were observed on the H-1 Freeway mainlines and ramps:

- Westbound on-ramps at University Avenue
- Westbound on-ramp at Alexander Street and Metcalf Street
- Westbound on-ramp at Punahou Street
- Westbound on-ramp at Lunalilo Street
- Westbound weave section between the H-1 on-ramp from Punchbowl Street and H-1 exit ramp to Pali Highway
- Eastbound weave section between the H-1 on-ramp from Pali Highway and H-1 off-ramp to Punchbowl Street
- Eastbound merge section from the H-1 on-ramps from Vineyard Boulevard and Ward Avenue

The PM corridor travel time from Nuuanu Bridge to 5th Street was about 10 to 11 minutes eastbound and approximately nine minutes westbound.

Closure of Access to H-1 Lunalilo On-Ramp during the AM Peak Period

The State of Hawaii Department of Transportation (HDOT) has implemented temporary closure of the H-1 westbound on-ramp from Lunalilo Street (also known as the Lunalilo on-ramp) from 6:00 to 9:30 AM on weekdays. Cones were deployed between the H-1 mainline and the existing Lunalilo on-ramp structure such that this on-ramp had become a local bypass lane from Lunalilo Street to Vineyard Boulevard during the AM peak hour. Access from H-1 to Vineyard Boulevard has been maintained though an opening in the cones, about 200 feet west of the exit, beginning under the Ward Avenue Bridge. The AM peak period closure of the Lunalilo on-ramp was intended to eliminate the traffic weaving between the Lunalilo on-ramp and the Vineyard off-ramp and improve the traffic flow on the H-1 Freeway. Before the closure of the ramp, the historical volume of the weave section was over 2,600 vehicles in the AM peak hour4. Since the closure of access to H-1, the Lunalilo on-ramp has become a local bypass lane, carrying

4 Source: *Interstate Route H-1: Lunalilo On-Ramp & Off-Ramp Improvement Study* (R.M. Towill Corporation, July 2001 [Project No. H1i-02-97])

approximately 1,000 vehicles from Lunalilo Street to Vineyard Boulevard during the AM peak hour. Traffic on H-1 can still exit Vineyard at the end of the cone deployment.

Approximately 2,200 vehicles exited the H-1 Freeway mainline to Vineyard during the AM peak hour. Therefore, Vineyard Boulevard carried roughly 3,200 vehicles in the Ewa-bound direction during the AM peak hour. Traffic using the Lunalilo on-ramp to access H-1 may have changed routes to use Vineyard Boulevard to connect to the on-ramp from Punchbowl Boulevard, or shifted to parallel arterials or cut through the neighborhood streets to travel further west (e.g., Vineyard Boulevard, School Street, Wilder Avenue, Beretania Boulevard, and Nimitz Highway).

During the PM peak hour, access from the Lunalilo on-ramp to H-1 remains open. The weave section between the Lunalilo on-ramp and the Vineyard Boulevard on-ramp carried almost 2,450 vehicles, of which 1,600 vehicles entered H-1 from the Lunalilo on-ramp and only 850 vehicles exited Vineyard Boulevard.

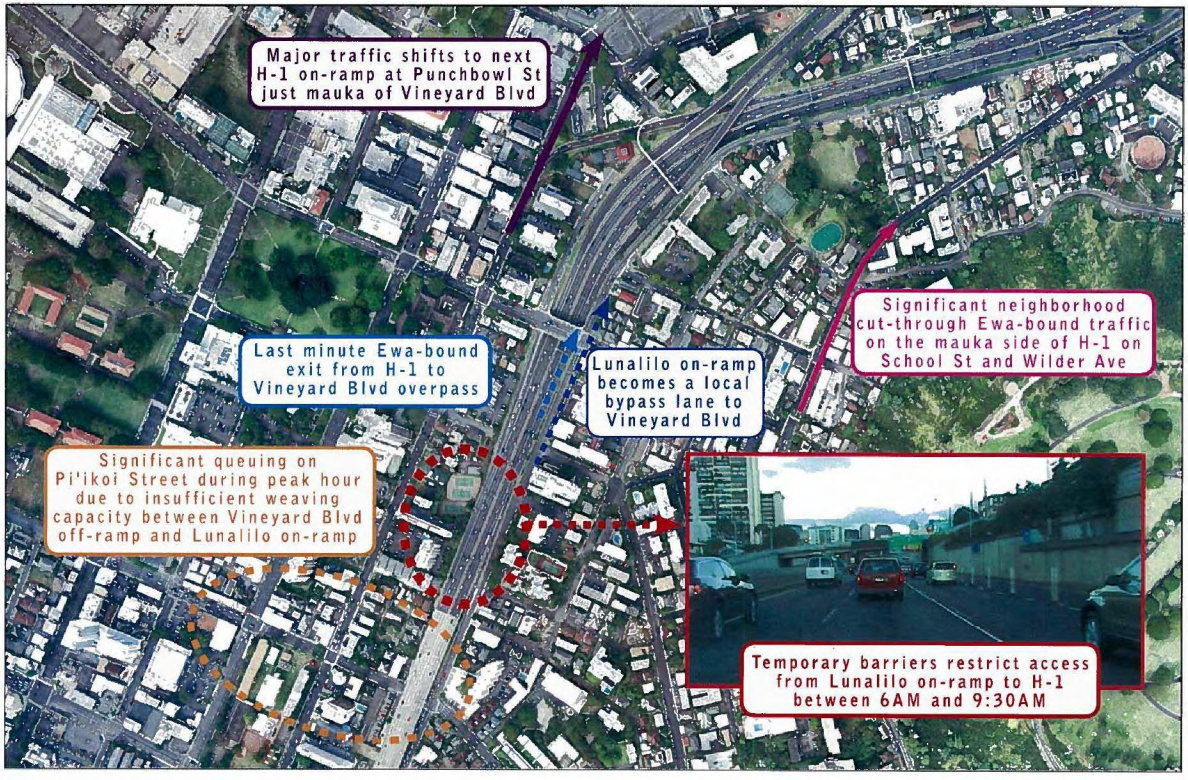
Figure 3 illustrates this bottleneck area due to restricted access from the Lunalilo on-ramp to the H-1 Freeway.

LOCAL CIRCULATION IN KAKA'AKO

Local circulation in Kaka'ako is provided primarily by two State Routes and major arterials. Pali Highway (SR-61) and Nimitz Highway (SR-92 or Ala Moana Boulevard in the study area) serve the study area for both regional and local circulation.

Pali Highway is one of the key mauka/makai routes to the Kalihi area, besides the Likelike Highway. Two travel lanes are provided in each direction from the H-1 Interchange to the Wyllie Street Interchange (one mile north of H-1). Continuing mauka-bound, Pali Highway provides three lanes in each direction. At Vineyard Boulevard, Pali Highway splits into two one-way makai-bound streets, with one connecting to the Fort Street Mall, and another transitioning into Bishop Street. During the AM peak hour, approximately 2,100 vehicles used Pali Highway to access the H-1 freeway to go to Downtown Honolulu and other communities in the study area, while approximately 620 vehicles exited H-1 to mauka-bound Pali Highway. In the PM peak hour, approximately 1,850 vehicles entered the H-1 Freeway from Pali Highway, while about 1,150 vehicles left the study area via Pali Highway. During the AM peak commute hour, an extensive queue was observed from Pali Highway inbound to the H-1 Freeway such that the average travel time was almost 15 minutes on Pali Highway from Wyllie Street to Vineyard (a 1.2-mile stretch). The makai-bound queue in the PM peak period was much shorter than in the AM peak period, but travelers still needed about nine to 10 minutes to get through this segment. The mauka-bound traffic flow on Pali was operating under much better conditions, so that the travel time for the same section took less than five minutes.

On a typical weekday, Nimitz Highway/Ala Moana Boulevard carried roughly 5,200 to 5,500 vehicles heading toward or leaving the study area during the AM and PM peak hours, while it carried about 2,700 to 3,300 vehicles from the Waikiki and McCully communities during the AM and PM peak hours. Three travel lanes are provided in each direction, with turn pockets provided at most of the intersections in the study area. Every morning, a major bottleneck occurs near the Aloha Tower and on the bridge crossing the Ala Wai Canal. In the afternoon, Koko Head-bound traffic was generally worse than Ewa-bound traffic. Heavy left-turn movements at the intersections for commercial uses on the mauka side of this corridor resulted in extensive queuing, which often exceeded turn pocket capacity at many intersections. The combination of commuter traffic to Waikiki and East Honolulu and retail trips to the commercial strips and the Ala Moana Shopping Center make the Koko Head-bound direction experience stop-and-go conditions. Due to the congestion and low posted speed limit (overall 25 miles per hour), the corridor travel time increased from about five minutes during the off-peak to beyond 15 minutes (even 30 minutes) for this two-mile section.



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MAJOR BOTTLENECK AREA DUE TO RESTRICTED ACCESS FROM LUNALILO ON-RAMP TO H-1

FIGURE 3

Principal Ewa-/Koko Head-bound arterials serving the study area include Vineyard Boulevard, the King Street/Beretania Street one-way couplet, Kinau Street, and Kapi'olani Boulevard on the makai side of the H-1 Freeway and Lunalilo Street and Wilder Avenue on the mauka side of the H-1 Freeway. The main mauka/makai roadways in the study area include Punchbowl Street, South Street, Ward Avenue, the Pensacola/Pi'ikoi Street one-way couplet, Punahou Street, Kalakaua Avenue, and McCully Street. Traffic conditions on these arterials, especially those mauka-/makai-bound roadways that have direct access ramps to H-1, are significantly affected by the traffic to and from the H-1 Freeway. For instance, traffic queuing at the eastbound on-ramp at Ward Avenue and westbound on-ramps at Lunalilo Street, Punahou Street, at Alexandra Street/Metcalf Street (via McCully Bridge) often extend beyond King Street.

Another example is on Lunalilo Street, where major crossing and merging affected traffic during the peak period:

- Traffic from the Makiki communities used neighborhood streets and the Ke'eaumoku bridge area and connected to Lunalilo Street, traveling Ewa-bound to use the Lunalilo on-ramp to H-1 or Vineyard Boulevard or continuing Ewa-bound to School Street
- Traffic from east Honolulu exited the H-1 Freeway, crossing Pi'ikoi Street and turning left at Pensacola Street to reach Downtown, the Kaka'ako or Ward communities.
- Traffic from the Kaka'ako, Ward and Ala Moana areas intending to use the Lunalilo on-ramp, via triple left-turn lanes at Pi'ikoi Street and then crossing Pensacola Street, merging into one lane before entering the on-ramp

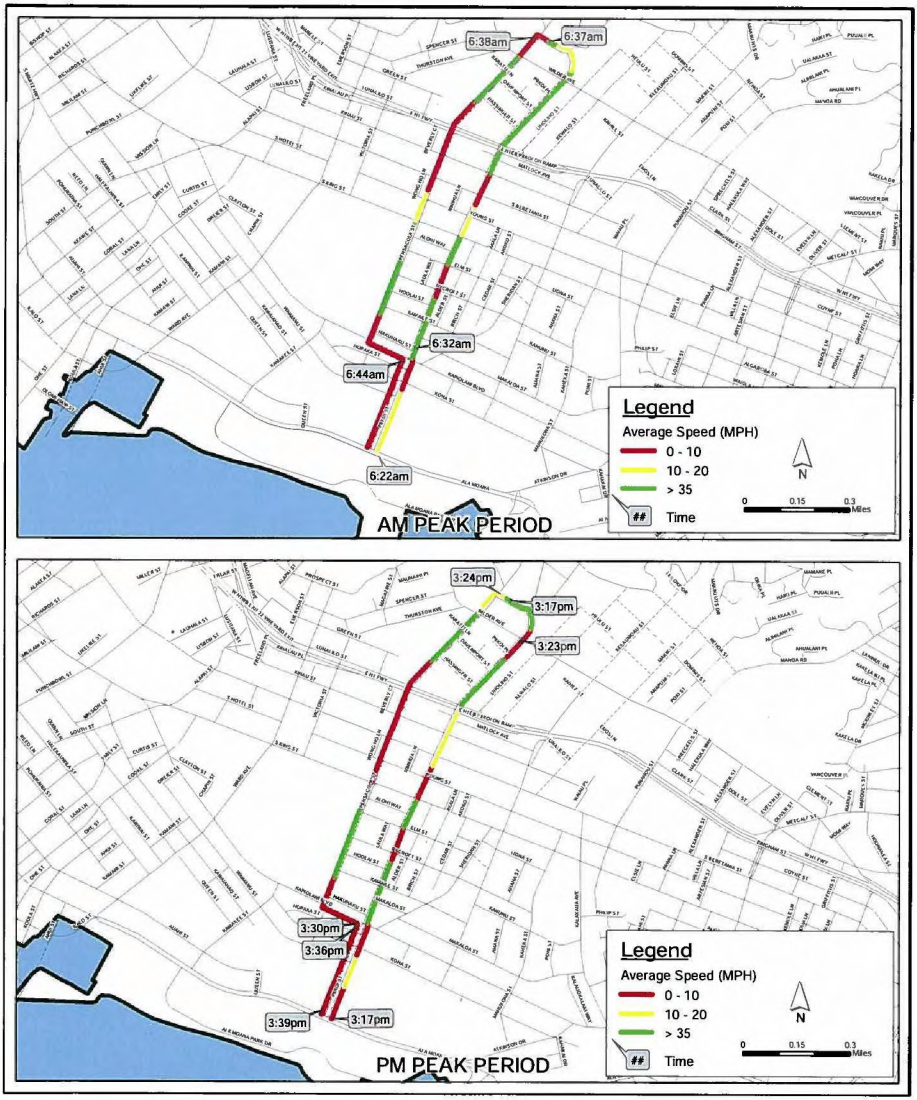
The study area is served by numerous bus routes and four shuttles. Most of the bus stops are on the far sides of the intersections. Dedicated passenger loading zones or bus pullout areas are provided in the vicinity of the public facilities or shopping centers. However, frequent services and curb side boarding often resulted in bus blockage to traffic on King Street, Beretania Boulevard, Kapi'olani Boulevard, and Ala Moana Boulevard.

Figures 4 to 7 illustrate the average travel speed and/or travel time conditions for selected corridors, including the Pi'ikoi Street/Pensacola Street Couplet, the King Street/Beretania Boulevard Couplet, Ala Moana Boulevard, Kapi'olani Boulevard, and Pali Highway.

Contraflow Operations

In or adjacent to the study area, the City and County of Honolulu has operated contraflow5 lanes by deploying cones along congested corridors during the commute peak periods, including portions of Kapi'olani Boulevard, Atkinson Drive, Ward Avenue, and Waiale Avenue. The reversible lane operations on Kapi'olani Boulevard have been interrupted intermittently due to the construction of the Kapi'olani Boulevard Water & Sewer Systems Improvement Project. This infrastructure project occurred during the preparation for the AA/DEIS for the HHCTCP, starting in summer 2007. The City and County resumed the reversible lane operations on Kapi'olani Boulevard and Atkinson Drive in December 2008, as described below:

5 Source: *Transportation Technical Report, Honolulu High-Capacity Transit Corridor Project* (City and County of Honolulu, August 15, 2008). "A contraflow lane typically provides vehicular travel in one direction, but is reversed during certain times of the day."



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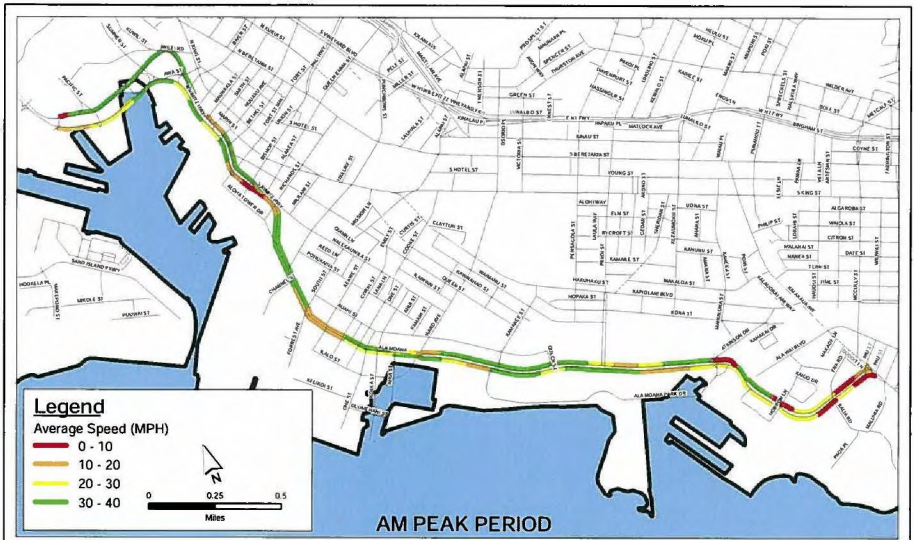
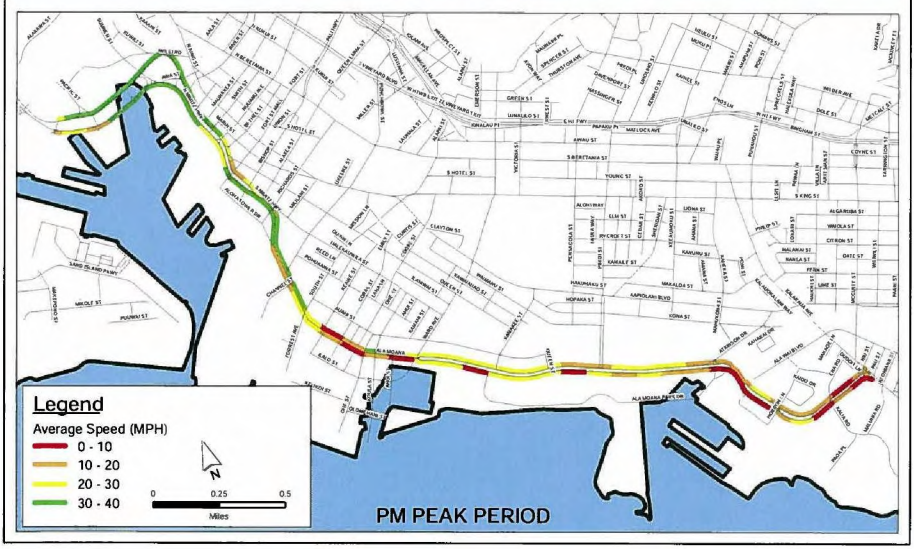
PIIKOI STREET AND PENSACOLA STREET
AM AND PM PEAK HOUR AVERAGE TRAVEL SPEED
FIGURE 4





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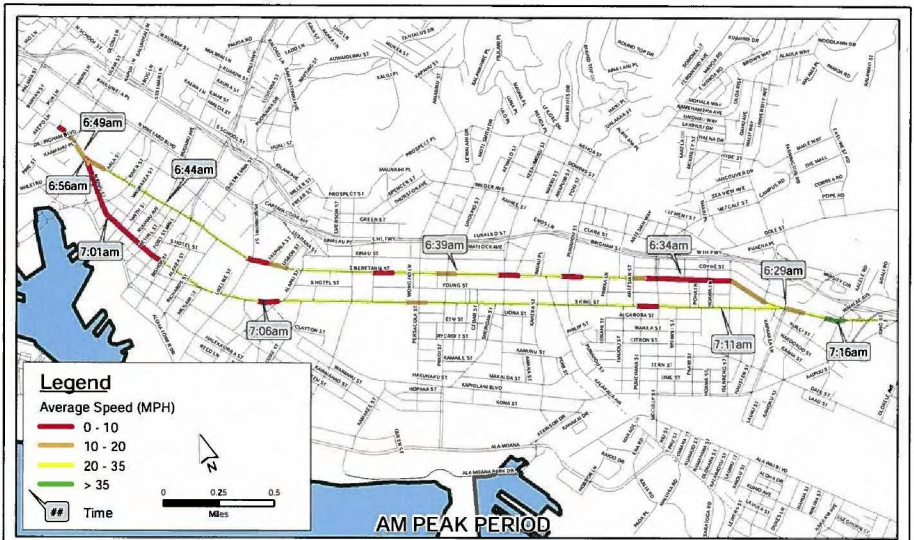
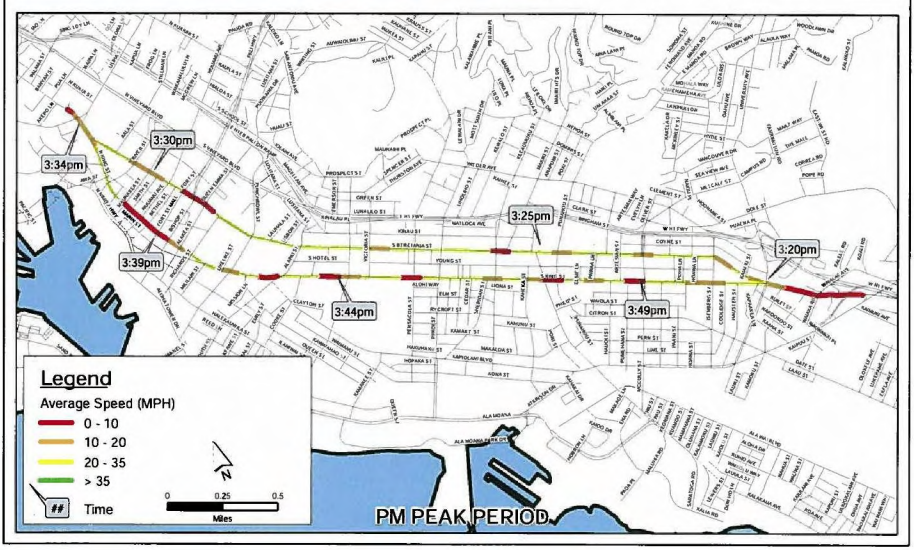
ALA MOANA BOULEVARD AND NIMITZ HIGHWAY
AM AND PM PEAK HOUR AVERAGE TRAVEL SPEED
FIGURE 5





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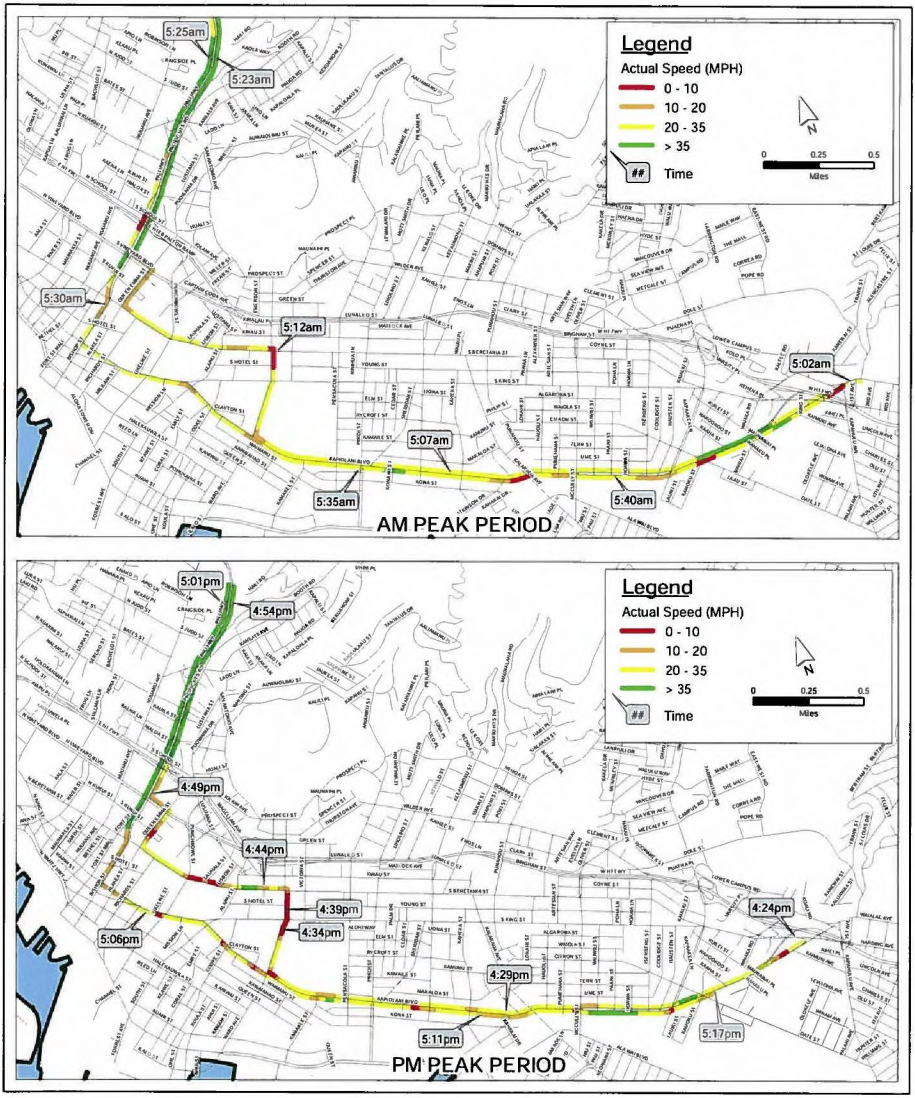
KING STREET AND BERETANIA BOULEVARD
AM AND PM PEAK HOUR AVERAGE TRAVEL SPEED
FIGURE 6



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KAPIOLANI BOULEVARD AND PALI HIGHWAY
AM AND PM PEAK HOUR AVERAGE TRAVEL SPEED
FIGURE 7

- Kapi'olani Boulevard: During the off-peak periods, Kapi'olani is a six-lane facility, with three lanes in each direction. The AM peak period contraflow operation on Kapi'olani Boulevard starts about 500 feet east of Date Street, with five westbound travel lanes and one eastbound travel lane. Between Date Street and South Street, it operates four westbound through lanes and two eastbound through lanes. In the PM peak period, the reversible lane starts from Wiliwili Street (just west of McCully Street) and ends at Kamakee Street. At the intersection of McCully Street and Kapi'olani Boulevard, the westbound lane and one westbound through lane are closed and only the two westbound through lanes are used. Between McCully Street and Kamakee Street, Kapi'olani Boulevard provides two westbound through lanes and four eastbound through lanes. To facilitate contraflow operations, left turns are usually restricted from the non-peak direction on Kapi'olani Boulevard to/from major north/south arterials (i.e., Kamakee Street, Ward Avenue, Kaheka Street, Kalakaua and Atkinson Drive).

- Atkinson Drive: Atkinson is a five-lane facility, with three mauka-bound travel lanes and two makai-bound travel lanes between Kona Street and Kapi'olani Boulevard. The AM contraflow provides two northbound through lanes and three southbound through lanes. The PM contraflow provides four northbound right-turn lanes from Atkinson Drive to Kapi'olani eastbound and one southbound lane in this section.

- Ward Avenue: The AM contraflow operation starts about 150 feet south of King Street in front of the Blaisdell Concert Hall, with three southbound lanes and one northbound lane. At the Ward Avenue/King Street intersection, the cone deployment sets up one northbound through lane, one northbound right-turn lane and three southbound through lanes. This AM contraflow ends just north of Lunalilo Street and H-1 since Ward Avenue north of Lunalilo narrows to only one lane in each direction. There is no PM contraflow operation on Ward Avenue.

- Waiale Avenue: Waiale Avenue is adjacent to the east boundary of the study area, with only PM contraflow operation. The PM contraflow starts between 7th Street and 8th Street, and ends at Kapahulu Avenue, with three eastbound through lanes and two westbound through lanes.

The contraflow operations facilitate the traffic flow in the peak direction of the above-mentioned facilities, however, they were also observed to result in longer queuing in the non-peak direction of these facilities when the demand of the non-peak direction remained high (e.g., Ward Avenue, Pi'ikoi Street, Ke'eaumoku Street, Kalakaua Avenue). The restriction of left turns also resulted in longer queuing for intersections with dedicated left-turn phases and increased right-turn movement in these corridors, especially to and from commercial driveways.

ACCESS TO PROPOSED GUIDEWAY TRANSIT STATIONS

Three guideway stations are proposed in the vicinity of the Kaka'ako-Makiki area, including Kaka'ako Station, Civic Center Station, and Ala Moana Station.

Kaka'ako Station

Located at the Ward Avenue/Queen Street intersection, the Kaka'ako Station is surrounded by a mix of apartment and commercial properties. Sidewalks on Ward Avenue are within typical widths. Sidewalks are missing or discontinuous in the small industrial zone on Queen Street near Ward Avenue. The bike path on Ala Mona Boulevard is the only available bicycle facility in the study area.

Key arterials serving the Kaka'ako Station area include Ward Avenue, Queen Street, Kamakee Street, Waimanu Street, Ahui Street, Kapi'olani Boulevard, and Ala Moana Boulevard. Most of the roadways in this area are used for local access and circulation rather than for long-distance commute travel. As a result, the traffic flow is generally slow and generates many stops and delays for motorists. However, most intersections operate at a reasonable or at least acceptable LOS (i.e., LOS D or better) during peak periods. The exception is the unsatisfactory LOS E observed at the Ward Avenue/Kapi'olani Boulevard intersection, where the contraflow operations on Kapi'olani Boulevard and Ward Avenue carry higher traffic volumes in the peaking direction and longer queuing lengths in the non-peak direction. Only one bus line, Route 6, currently operates on Ward Avenue.

Civic Center Station

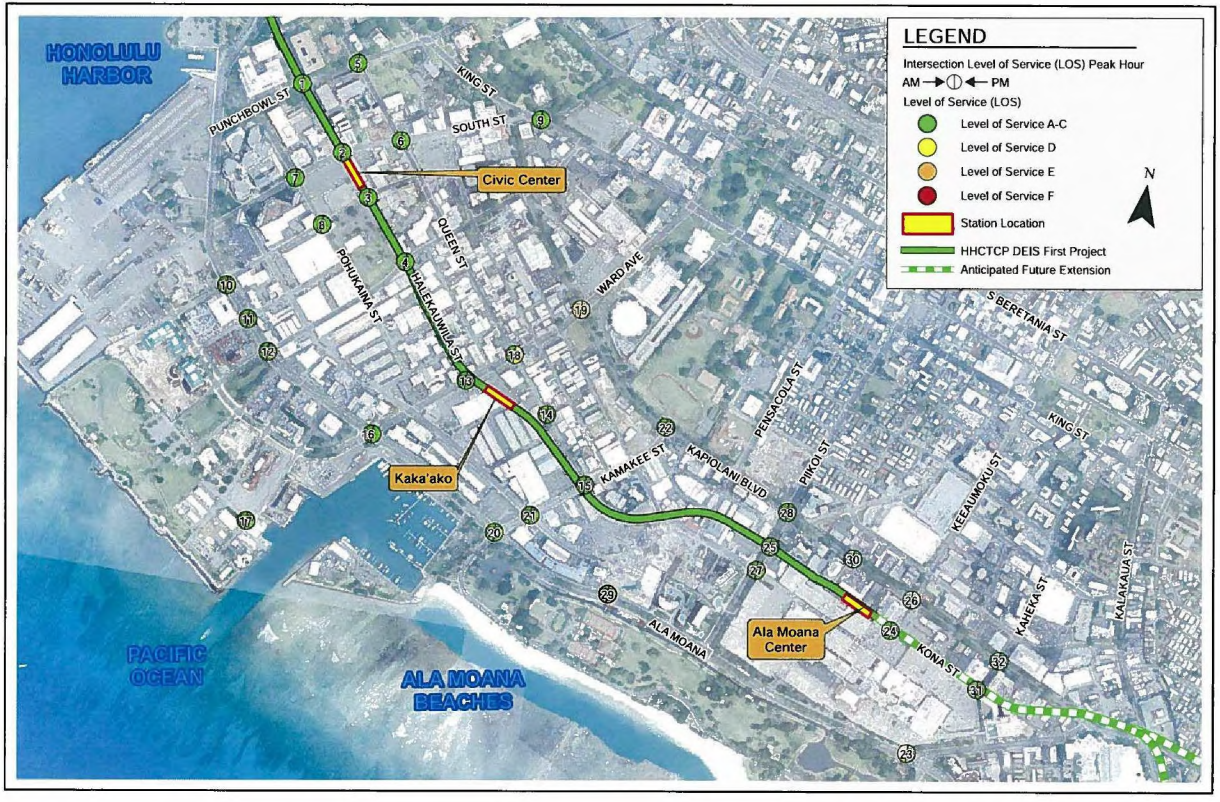
This proposed Civic Center Station would be located on Halekauwila Street between South Street and Keawe Street. Immediately adjacent to the station are under-utilized commercial parking lots and private properties, with major public sector facilities within walking distance. Several high-density residential towers or commercial development projects are under construction along South Street. It is expected that the major mode of access to this station would be via walking or bicycles. Sidewalks and pedestrian crossings to the station are available but not heavily used. No dedicated bike facilities are available to serve the station area.

Vehicular access to this station area is primarily via Halekauwila Street, South Street, Keawe Street and Cooke Street, and Ala Moana Boulevard. These streets tend to carry relatively high volumes of traffic each day, but volumes are well distributed over the entire day as opposed to concentrating during peak periods. Key arterial intersections that provide access to the station are operating good levels of service (LOS C or better) during both peak periods. TheBus services are available on South Street (Routes 42, 85/85A, 88, and 89) and Queen Street (Route 6).

Ala Moana Station

Located at the Kona Street/Ke'eaumoku Street intersection, the proposed Ala Moana Center station is adjacent to the Ala Moana Shopping Center, a large arcade of high-middle and low-end shopping mall. The station area has a high level of urban density, with commercial complexes and some residential and apartment communities. This station would be the multi-modal transfer terminus of the First Project Alternative as described in the DEIS. Numerous bus lines are serving the station area and the Ala Moana Shopping Center, including Routes C, 5, 6, 8, 17, 18, 19, 20, 23, 40/A, 43, 51, 52, 53, 56, 57, 57A, 65, 88A on Kona Street, Routes A, 3, and 9 on Kapi'olani Boulevard, and Routes E, F3, 42, and 98A on Ala Moana Boulevard). Significant bus transfers and walk trips to and from the rail station are expected. However, pedestrian access to Kapi'olani Boulevard is restricted, and people currently walk down an alley way between buildings for access. The area around the Ala Moana Station has the potential for vehicle/pedestrian conflicts, especially when pedestrians cross Kona Street near the Ala Moana Shopping Center.

Vehicular access to the Kaka'ako Station area is provided by Kona Street, Ke'eaumoku Street, Mahukona Street, Kapi'olani Street, the one-way couplet of Pi'ikoi Street and Pensacola Street, Waimanu Street, Atkinson Drive, and Ala Moana Boulevard. Traffic conditions near the station are largely affected by trip generation of the Ala Moana Shopping Center and the queuing conditions of the traffic to and from H-1 ramps on Lunalilo Street via Pi'ikoi Street, Pensacola Street and Ke'eaumoku Street. Left-turn restrictions on Kapi'olani Boulevard and Atkinson Drive make local circulation somewhat difficult. Except the poor level of service observed at the intersection of Ke'eaumoku Street & Kapi'olani Boulevard during the PM peak hour, the remaining intersections surrounding the station are operating at acceptable LOS D or better during both peak hours. Figure 8 illustrates the intersection operating LOS conditions for the station areas.



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EXISTING INTERSECTION OPERATING CONDITIONS
ADJACENT TO FUTURE GUIDEWAY STATIONS
FIGURE 8

5. FUTURE BASE CONDITIONS

According to the DEIS[6], the Kaka'ako area is expected to experience major population and employment growth from approximately 7,000 residents and 23,400 jobs in year 2000 to approximately 33,000 residents and 33,800 jobs by year 2030. The Kaka'ako area is expected to undergo a change in land use makeup from primarily industrial uses to a high-density residential and commercial mix.

FUTURE 2030 BASELINE ROADWAY IMPROVEMENTS

A review of future baseline transportation improvement projects was conducted for the study area. Sources for the development of this project list include:

- *2030 Oahu Regional Transportation Plan* (ORTP) (Kaku Associates, Inc., March 9, 2007)
- *Oahu Transportation Improvement Program FYs 2008-2011 (2008-2011 TIP), as amended through Revision #6* (O'ahuMPO, July 22 , 2008)
- *Semi-Annual Status Report for Projects Programmed in FY 2008 of the FYs 2008-2011 Transportation Improvement Program* (OahuMPO, September 30, 2008)
- *Draft Mauka Area Plan - Kaka'ako Hawaii Community Development District (KHCDD), Honolulu, Hawaii* (HCDA, May 2007)
- *Ward Neighborhood Master Plan* (GGP, April 16, 2008)

The 2030 ORTP includes projects for which there is believed to be a high degree of commitment on the part of the City and/or the State, while the 2008-2011 Transportation Improvement Program (TIP) and its semi-annual report include the adopted project list public transit, highway, bicycle, and pedestrian projects that will receive federal transportation funds in the near future. Therefore, transportation improvement projects from the TIP and ORTP are assumed to be have been implemented by 2030, and therefore, will be incorporated into the baseline 2030 travel demand model forecasts for the Kaka'ako Traffic Study. Projects in the 2008-2011 TIP relating to safety and maintenance/operation of existing facilities (e.g., resurfacing, rehabilitation, bridge replacement, bus fleet replacement or maintenance, traffic control center operations, etc.) will not be specifically modeled in the 2030 baseline improvement list for this study since these are not performance-enhancing on a regional scale. In addition, a few roadway projects to improve neighborhood connectivity are currently proposed in Kaka'ako Community Plan District and Ward Neighborhood Master Plan. These projects were also evaluated in the development of the project lists for the Kaka'ako Traffic Study.

As shown in Table 1, only the first project proposed by the ORTP 2030, "widening the H-1 Freeway from Ward Avenue and Punahou Street," would result in significant change to existing transportation system on a regional scale.

In addition, the proposed modification to the existing Pensacola and Pi'ikoi couplet by ORTP 2030 and Draft Mauka Area Plan for the KCDA and construction of the addition of eastbound right turn from Kinau Street to the Vineyard on-ramp to H-1 would result in roadway operations changes significantly different from the existing traffic conditions, which then would not provide a fair evaluation of the benefits and

6 Source: *Honolulu Capacity Transit Corridor Project - Draft Environmental Impact Statement/Section 4(f) Evaluation* (City and County of Honolulu November 2008)

TABLE 1

FUTURE BASELINE ROADWAY IMPROVEMENTS

ID	Source	Project Title	Project Description
1	ORTP 2030	S48. Interstate Route H-1, Widening, Ward Avenue to Punahou	Widen the existing H-1 by1 lane in the eastbound direction, from Ward Avenue to Punahou Street.
2	2008-2011 TIP Semi-annual	S16. Guardrail and Shoulder Improvements, Various Locations	Install and upgrade existing guardrails to bridge end post connections, bridge railing, guardrail end terminals, crash attenuators, miscellaneous drainage, and other appurtenant improvements. Planned intersections include: 1. Interstate H-1 - Palailai Interchange to Ainakoa Ave 16. Pali Highway and Kalanianole Highway - Vineyard Blvd to Kailua Rd
3	2008-2011 TIP Semi-annual	S17. Interstate Route H-1, Guardrail and Shoulder Improvements, Kapiolani Interchange to Ainakoa Avenue	Install and/or upgrade existing guardrails, crash cushion, and concrete barriers to meet current standards.
4	2008-2011 TIP Semi-annual	S18. Interstate Route H-1, Guardrail and Shoulder Improvements, Middle Street to Punchbowl Street	Install and/or upgrade existing guardrails, crash cushion, and concrete barriers to meet current standards.
5	2008-2011 TIP Semi-annual	S22. Interstate Route H-1, Lunalilo St Off-Ramp and On-Ramp	Improve the westbound lanes by modifying the weaving movements between the Lunalilo Street on-ramp and the Vineyard Boulevard off-ramp. It is in the planning stage. Alternatives are being assessed: replacing the temporary barriers that are currently being used to close the Lunalilo on-ramp in the AM, with a more permanent moveable concrete Zippable barrier, constructing a left lane cutoff/flyover ramp to eliminate weaving motions on the ramp section.
6	2008-2011 TIP Semi-annual	S32. Interstate Route H-1, Seismic Retrofit, Pali Highway Overpass and Nuuanu Avenue Separation	Retrofit interchange structure to meet current SEISMIC standards
7	2008-2011 TIP Semi-annual	S39. Interstate Routes H-1 and H-2, Destination Sign Upgrade/Replacement	Replace and/or upgrade the existing destination signs and sign support structures on Interstate Routes H-1 and H-2.
8	2008-2011 TIP Semi-annual	S93. Traffic Signal Modernization, Various Locations, Waialae Avenue $4,342,000 Obligated. and Nimitz, Farrington, Pali, and Likelike Highways	Improve traffic signals at various locations including Pali Hwy and School St. The remaining intersections are outside of the project area.
9	2008-2011 TIP Semi-annual	S97. Ala Moana Boulevard and Nimitz Highway, Resurfacing and Highway Lighting Replacement, Fort Street Mall to Holomoana Street	Resurface roadway and improve lighting on Ala Moana Boulevard and Nimitz Highway from Fort Street Mall to Holomoana Street. It may include utility and street lighting improvements. Scope of the project depends on available funds with possible delay/deletion of some of the improvements. (S01 was added to S97. S01: Perform Operational and safety improvements at the Piikoi Street and Ala Moana Boulevard intersection.)
10	2008-2011 TIP Semi-annual	C04. Kapiolani Boulevard Reconstruction, Phases 1 and 2	Reconstruct Kapiolani Boulevard to restore deteriorated pavement through use and/or disturbed by the installation of utilities, transit, and other roadway infrastructure improvements. Phase 1 (South Street to Ward Avenue). Phase 2 (Ward Avenue to Kalakaua Avenue)
11	2008-2011 TIP Semi-annual	C10. Traffic Improvements at Various Locations.	Provide for traffic congestion relief and improve traffic safety at the Ala Wai Blvd and McCully St, McCully St from Kapiolani Blvd to Beretania St. The remaining intersections are outside of the project area.
12	2008-2011 TIPSemi-annual	C13. Traffic Signals at Various Locations	Install and upgrade traffic signals islandwide, including Americans with Disabilities Act (ADA) improvements, signs and markings, and interties. The project provides for the safe and orderly movements of pedestrians and vehicles at high-risk intersections. The project upgrades existing intersections, adds left-turn phases, increases signal visibility, improves signal coordination, and makes ADA improvements. Project work is warranted by the Manual of Uniform Traffic Control Devices (MUTCD) and selected annually. Phase 10-FY 2008 Construction Funds: 4. Kinau St and Victoria St (Upgrade Intersection) 5. South Beretania St and Victoria St (Upgrade Intersection) Phase 11-FY 2008 Design & FY 2009 Construction Funds: 1. South King St and Mililani St (New Signal) 2. McCully St and Waiola St (New Signal) 3. Makaloa St and Poni St (New Signal) Phase 13-FY 2010 Design & 2011 Construction Funds: 1. University Ave and Metcalf St (Left-Turn Phase) 2. Nuuanu Ave and School St (Left-Turn Phase) 5. University Ave and Coyne St (New Signal) Phase 14-FY 2011 Design & 2012 Construction Funds: 1. South St and Kawaiahoa St (New Signal) 2. Kapiolani Blvd and Date St (Upgrade Intersection) 4. Kapiolani Blvd and Ward Ave (Upgrade) 5. South King St and Ward Ave (Audio Ped Signal) 6. South Beretania St and Ward Ave (Audio Ped Signal) 7. South King St and Pensacola St (Audio Ped Signal) 8. South Beretania St and Pensacola St (Audio Ped Signal)

Source:

[a] Oahu Transportation Improvement Program FYs 2008-2011 (2008-2011 TIP) , as amended through Revision #6, Oahu Metropolitan Planning Organization (OahuMPO), July 22 , 2008

[b] Semi-Annual Status Report for Projects Programmed in FY2008 of the FYs 2008-2011 Transportation Improvement Program , OahuMPO, September 30, 2008

effects of the potential roadway improvements in this document. Therefore, the planned changes to Pensacola-Pi'ikoi Couplet and the Kinau Street on-ramp were not assumed in the analysis of the 2030 Baseline Conditions in this report. Appendix A addresses the effect of the possible reversal of the one-way couplet of Pensacola-Pi'ikoi Streets.

FUTURE 2030 BASE CONDITIONS

Traffic conditions in the study area can be described by system-wide travel statistics, including VMT, VHT and VHD7. Effectiveness of the transportation system can be assessed based on reduction in VMT. VHT and VHD indicate how additional travel demand may influence congestion in the system from a travel time standpoint. As shown in Table 2, the systemwide peak period VMT is projected to increase by about 14% or 36,500 vehicles between 2008 and 2030. The increased traffic demand would mostly likely fall on the regional highway and on major arterials. Systemwide vehicle delay is expected to increase by 36%, primarily due to the projected traffic congestion on regional highways and major arterials.

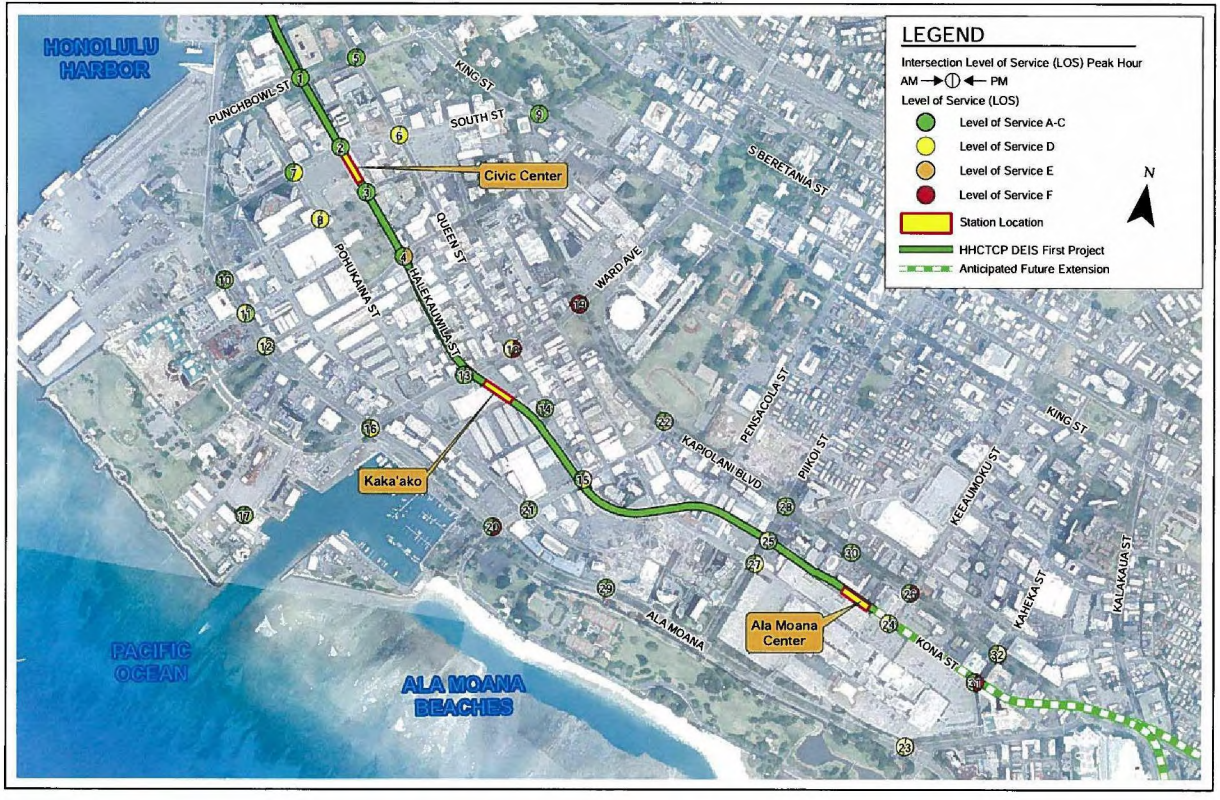
In the afternoon, traffic congestion starts as early as mid-afternoon to early evening. The change in land use and population from existing to 2030 conditions is expected to have a greater effect in the PM peak period than the AM peak period. Analysis of the traffic demand for the four hours from 2:30 to 6:30 PM indicates that much worse congestion may occur in 2030 so that systemwide travel delay may increase significantly (more than double). The average VMT per vehicle is projected to increase from 1.85 to 1.86 in the AM peak period and from 1.52 to 1.59 in the PM peak period. This increase in average trip length per vehicle may be due to increased commute trips from the future development on the Ewa side of the O'ahu Island (Kapolei and Kalaeloa areas) and the Central O'ahu area, or extended traffic rerouting to avoid congestion on major highways or arterials.

Future 2030 traffic conditions near the station areas were also analyzed, as shown in Figure 9. Several intersections adjacent to future guideway stations that currently operate at acceptable LOS may potentially operate at worse or failing conditions due to future congestion, including:

- Ward Avenue/Queen Street, Ward Avenue/Kapi'olani Boulevard, Kamakee Street/Ala Moana Boulevard in the vicinity of Kaka'ako Station
- Cooke Street/Halekauwila Street near Civic Center Station
- Kona Street/Ke'eaumoku Street, Kapi'olani Boulevard/Ke'eaumoku Street, and Kona Street/Kaheka Street near Ala Moana Center Station

With the planned construction of the fixed guideway transit system, it is expected that some drivers may leave their cars and use the integrated guideway transit and TheBus services or other non-motorized mode. However, to accommodate projected population growth, additional roadway improvements would be needed to satisfy mobility needs as well as alleviate the bottlenecks and hotspots identified under existing conditions and future conditions.

7 Based on *Transportation Technical Report, Honolulu High-Capacity Transit Corridor Project.* "VMT is computed by multiplying the number of trips on a roadway by the facility's total length. This reveals the total mileage traveled. VHT is derived by multiplying the number of trips on a roadway by the travel time for each trip. VHD is calculated by finding the difference between the congested VHT and the VHT that would be expected under free-flow conditions. "



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2030 BASELINE INTERSECTION OPERATING CONDITIONS ADJACENT TO FUTURE GUIDEWAY STATIONS

FIGURE 9

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TABLE 2 PEAK PERIOD SYSTEMWIDE TRAVEL STATISTICS			
Performance	**Existing (2008)**	**2030 Base**	**% Change from Existing to 2030 Base**
SYSTEMWIDE PERFORMANCE - AM PEAK PERIOD (Two-Hour from 6:00 to 8:00 AM)			
Systemwide (Regional Freeway, Arterials, Collectors/Local Streets)			
VMT [mi]	252,000	288,500	14%
VHT [hr]	10,900	13,400	23%
VHD [hr]	3,900	5,300	36%
VMT per vehicle [mi]	1.85	1.86	1%
Regional Freeway (H-1 and Pali Hwy)			
VMT [mi]	99,100	110,100	11%
VHT [hr]	3,100	3,800	23%
VHD [hr]	1,400	1,800	29%
Major arterials			
VMT [mi]	104,300	122,200	17%
VHT [hr]	4,800	6,000	25%
VHD [hr]	1,200	1,800	50%
SYSTEMWIDE PERFORMANCE - PM PEAK PERIOD (4 hour from 2:30 to 6:30 PM)			
Systemwide (Regional Freeway, Arterials, Collectors/Local Streets)			
VMT [mi]	510,600	613,100	20%
VHT [hr]	22,000	29,200	33%
VHD [hr]	7,700	12,000	56%
VMT per vehicle [mi]	1.52	1.59	5%
Regional Freeway (H-1 and Pali Hwy)			
VMT [mi]	189,100	220,100	16%
VHT [hr]	5,800	7,600	31%
VHD [hr]	2,400	3,700	54%
Major arterials			
VMT [mi]	225,400	279,300	24%
VHT [hr]	10,500	14,300	36%
VHD [hr]	3,000	5,000	67%
Source: Fehr & Peers (Visum Traffic Forecasting Model)			

6. RECOMMENDED IMPROVEMENTS

This section presents recommendations for improvements to the transportation system in the Kaka'ako-Makiki area. The recommendations were developed based on the understanding of the issues of regional and local access issues under both existing and future 2030 condition, as measured by various indicators, such as systemwide travel statistics, travel time, and operating level of service. Multiple iterations of the project list development and evaluation process were conducted.

RECOMMENDED IMPROVEMENTS

Table 3 provides the final list of potential roadway and circulation improvements expected to improve the traffic operating conditions in the vicinity of future guideway stations and enhance the regional and operation efficiency of the regional highway system. This table also describes elements and benefits for each project.

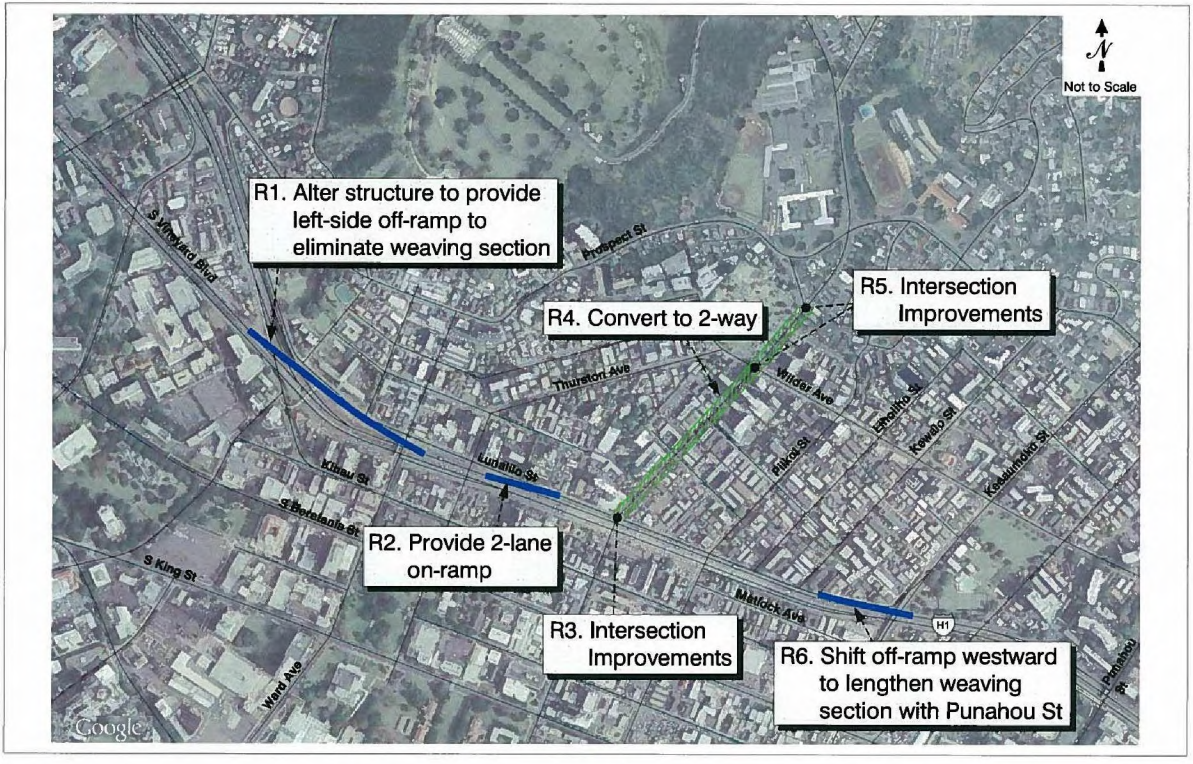
The following describes the key elements of the projects that are recommended for implementation and the overall benefits of the Plan.

Projects to Improve Access to the H-1 Freeway

A total of 12 projects were recommended to facilitate traffic accessing the H-1 Freeway. Figures 10A and 10B list the locations of these 12 projects. Six of the 12 projects are targeted to facilitate the traffic operations on the H-1 Ewa-bound lanes between the Pensacola off-ramp and the Vineyard off-ramp and the adjacent intersections.

- Lunalilo On-Ramp and Vineyard Off-Ramp (Projects R1 and R2): There is a short weaving section between the Lunalilo Street on-ramp and the Vineyard Boulevard off-ramp. If the Lunalilo Street on-ramp provided access to R1, during the peak period, this weaving section would need to be eliminated to reduce congestion on H-1. Therefore, it is recommended that the H-1 Freeway structure be altered to provide a two-lane left-side off-ramp onto Vineyard Boulevard. The existing three-lane approach segment would gain an "exit only" lane on the left, and the left lane would have an option to exit onto Vineyard Boulevard. If Project R1 is implemented, two lanes would be provided on the Lunalilo Street on-ramp, which would merge into a single lane before merging with H-1 after the Vineyard Boulevard off-ramp. Vehicles entering H-1 from the two-lane on-ramp at Lunalilo Street would be allowed to access H-1 but not Vineyard Boulevard. Additional right-of-way would be required to accommodate the column placement on the mauka side of the H-1 Freeway at Lunalilo Street and Ward Avenue. The pedestrian bridge Ewa of Ward Avenue would be relocated further west.

- Lunalilo Street/Pensacola Street/Pi'ikoi Street (Projects R3, R4, R5): Due to the topography of the island and geometry constraints, there is no easy access to H-1 Ewa-bound lanes west of the Punahou Street interchange. Vehicles from south of H-1 must utilize Pi'ikoi Street or Ke'eaumoku Street and vehicles from north of H-1 but west of Pi'ikoi Street must make a left turn from Wilder Avenue to Pi'ikoi Street to access the school to the north. To improve the traffic queuing conditions on Lunalilo Street and Pi'ikoi/Pensacola Street Couplet, conversion of Pensacola Street mauka of Lunalilo Street to just north of Wilder Avenue to two-way operations (with one lane northbound and two lanes southbound), supplemented by restriping the lane alignment at the adjacent intersections: Lunalilo Street/Pensacola Street, Pi'ikoi Street/Kinau Street/Lunalilo Street, Pensacola Street/Wilder Avenue/Pi'ikoi Street is recommended.



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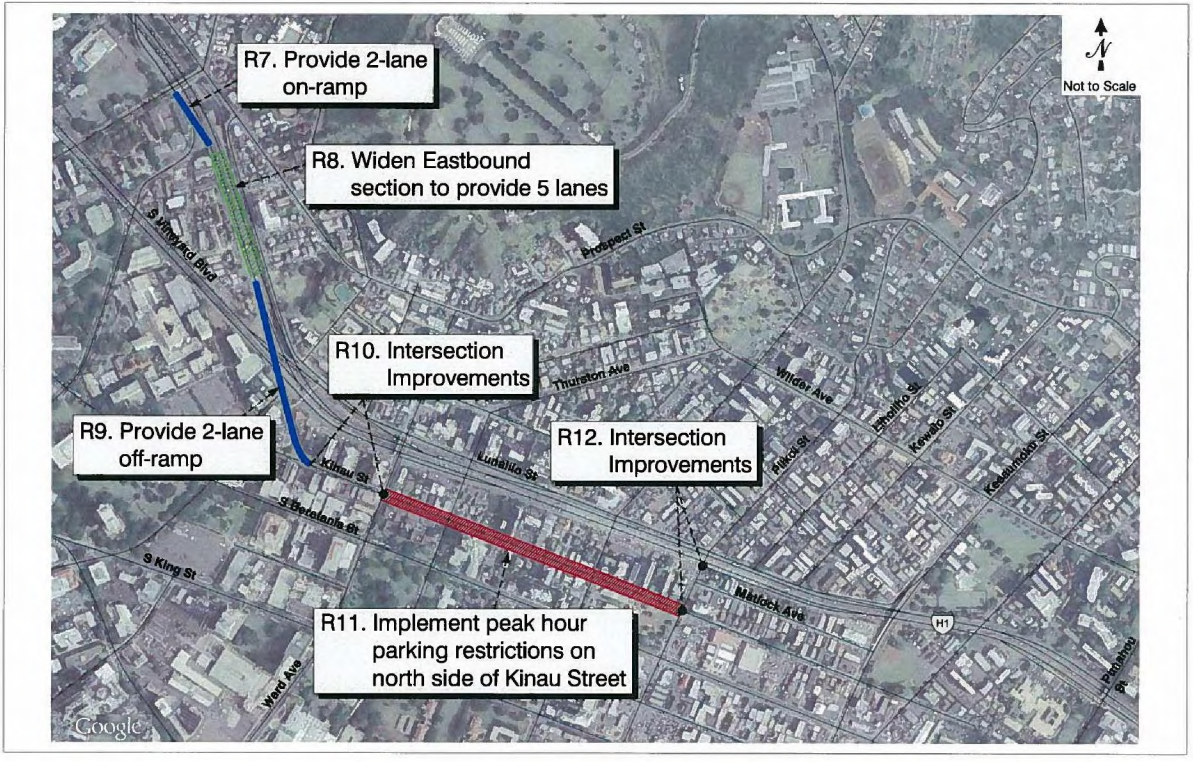
RECOMMENDED ROADWAY IMPROVEMENTS
REGIONAL ACCESS TO H-1 WESTBOUND

FIGURE 10A



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RECOMMENDED ROADWAY IMPROVEMENTS
REGIONAL ACCESS TO H-1 EASTBOUND

FIGURE 10B

- H-1 Westbound Off-Ramp at Lunalilo Street (Project R6): The short weave section between the Lunalilo westbound off-ramp and Punahou on-ramp has caused congestion on H-1. It is recommended that the Lunalilo off-ramp be shifted westward closer to Liholiho Street to lengthen the weaving section with Punahou Street.

Figures 11A and 11B illustrate the concepts for the recommended and alternative reconfiguration of the Vineyard off-ramp and Lunalilo on-ramp.

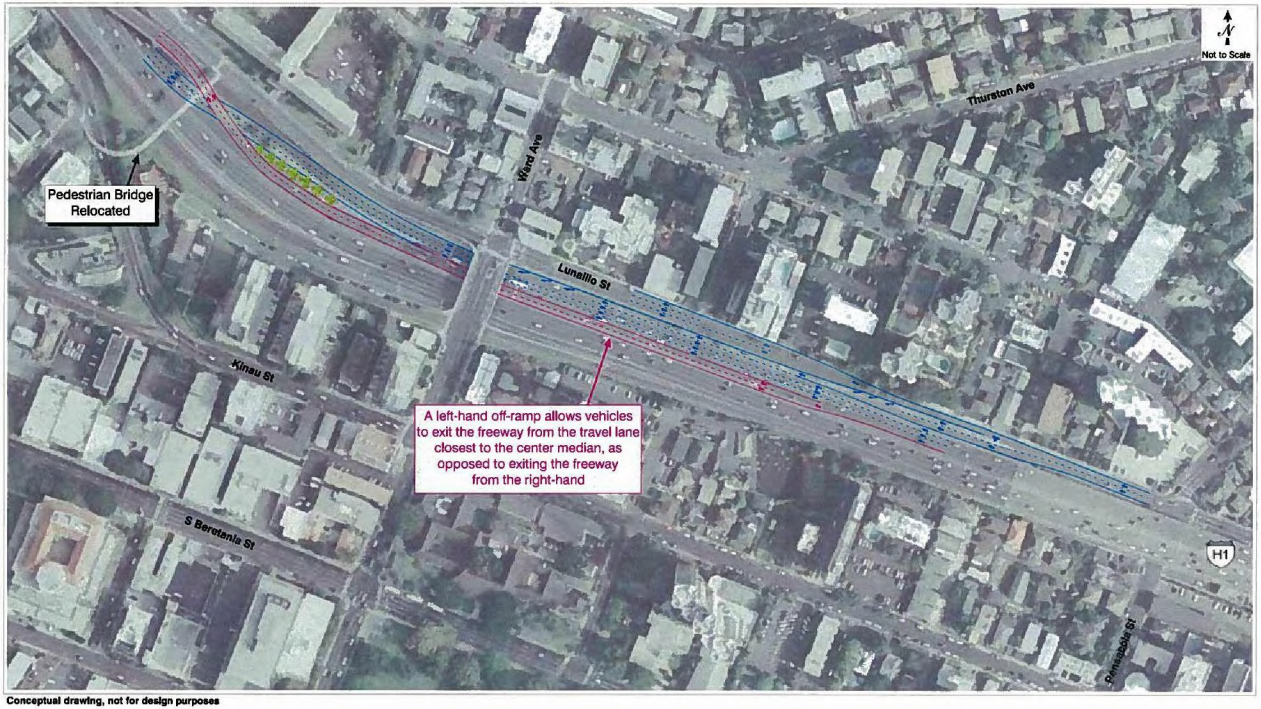
The remaining six projects are aimed to increase the carrying capacity of H-1 Koko Head-bound operations from the Pali Highway to the Kinau off-ramp and the peak hour capacity on Kinau Street.

- H-1/Pali Highway Interchange (Projects R7 and R8): During the AM peak commute hour, an extensive queue was observed from the Pali Highway/H-1 Freeway interchange. The AM two-hour peak period traffic volumes (roughly 3,800 vehicles) exceed the capacity (roughly 3,000 vehicles) of the existing one-lane on-ramp. To facilitate traffic entering the study area, Project R7 includes widening the H-1 on-ramp from allow two lanes from the Pali Highway. The existing three-lane auxiliary segment would need to be restriped to provide one trap lane onto the H-1 on-ramp, one trap lane onto the Punchbowl Street off-ramp, and one lane with access to both. A physical barrier would be provided to restrict H-1 off-ramp traffic bypassing to the Punchbowl Street off-ramp. Project R8 includes widening H-1 eastbound mainline from the Pali Highway on-ramp to the Kinau Street off-ramp by one lane to allow two lanes to enter from Pali Highway to H-1.

- H-1 Eastbound Off-Ramp at Kinau Street (Project R9): The Kinau off-ramp is the first direct access to the Kaka'ako/Makiki area for commuter traffic from west Honolulu. The AM peak period traffic volume (roughly 2,700 vehicles) at this off-ramp is near the capacity (roughly 3,000 vehicles) of the existing one-lane on-ramp. The recommendation would widen this off-ramp to provide two lanes from H-1. This improvement is also needed to accommodate the additional H-1 lane from Project R8.

- H-1 Eastbound Off-Ramp/Kinau Street and Kinau Street/Ward Avenue Intersections (Project R10): At the intersection of H-1 eastbound off-ramp/Kinau Street intersection, vehicles from the uncontrolled eastbound through movement that wish to make a left turn onto Ward Avenue must cross vehicles from the off-ramp that wish to make a right turn onto Ward Avenue, effectively creating a weaving section. There is also a high speed differential between the two movements, making this weave very difficult and dangerous. To improve the safety at this ramp intersection, the plan calls for (1) installation of a physical barrier to eliminate the stop-controlled eastbound through movement while providing side-street stop-control on the existing uncontrolled eastbound through lane, and (2) restriping the eastbound approach to the Kinau Street/Ward Avenue intersection to provide a shared through/left-turn lane, two through lanes, and a right-turn lane.

- Kinau Street between Ward Avenue and Pi'ikoi Street (Project R11): Kinau Street provides two lanes in the eastbound direction with parking on both sides. This section is recommended to be widened to alleviate congestion on H-1 and King Street. It is suggested that peak hour parking restrictions be implemented and "Anti-Gridlock Zone" signs on one side of Kinau Street between Ward Avenue and Pi'ikoi Street to provide three lanes in the eastbound direction.



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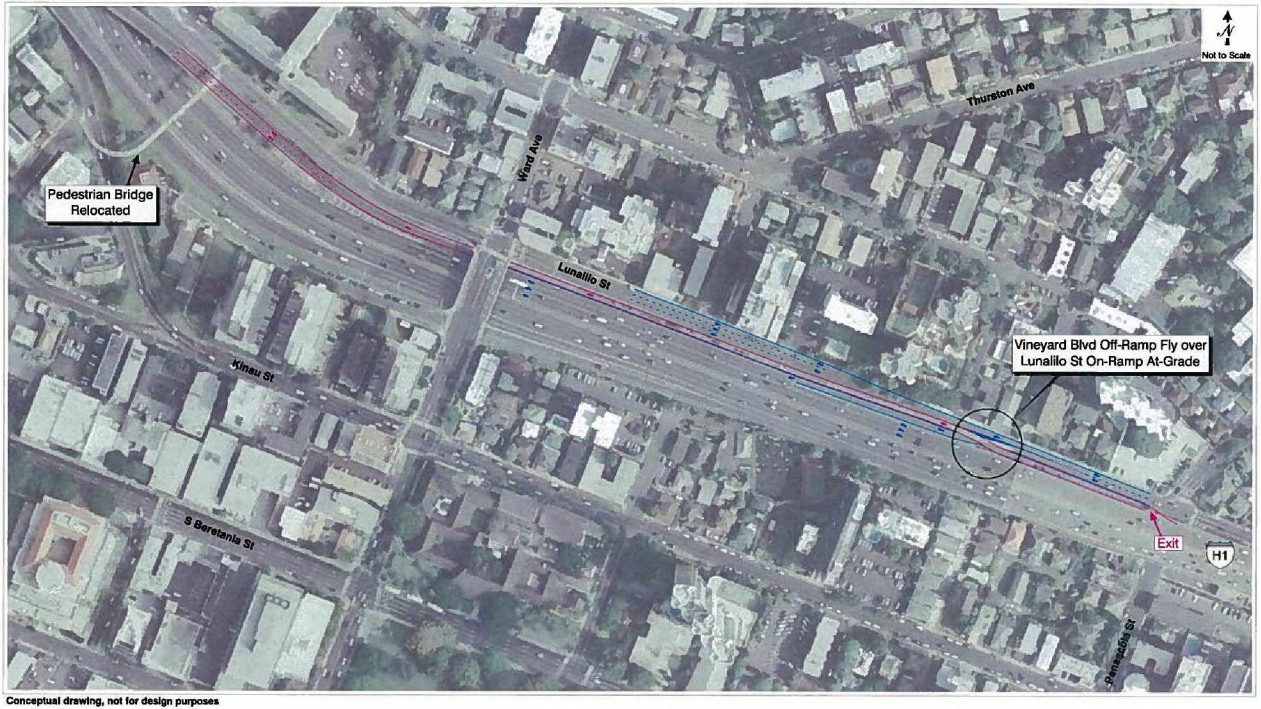
RECOMMENDED PLAN - PROJECT R1
RECONFIGURATION OF H-1 WESTBOUND VINEYARD OFF-RAMP AND LUNALILO ON-RAMP
FIGURE 11A



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ALTERNATIVE PLAN - PROJECT A1
RECONFIGURATION OF H-1 WESTBOUND VINEYARD OFF-RAMP AND LUNALILO ON-RAMP
FIGURE 11B

TABLE 3

RECOMMENDED REGIONAL AND LOCAL ROADWAY IMPROVEMENT PLAN FOR THE HAWAII BAREKIOPE TRAFFIC STUDY

Types	Project #	Facility	Need for Improvements	Project Description	Benefits	Cost Estimates (Millions of Year 2008 Dollar) [a]
Regional Roadway Improvements to Enhance H-1 Freeway Access	R 1	H-1 Westbound Left Hand Side Off-Ramp at Vineyard Boulevard	A short weaving section exists between the Lunalilo Street on-ramp and the Vineyard Boulevard off-ramp. If the Lunalilo Street on-ramp provided access to H-1 in the AM peak period, this weaving section would need to be eliminated to reduce congestion on H-1.	(1) Alter structure to provide a two-lane left-side off-ramp onto Vineyard Boulevard. The existing 3-lane approach segment would gain an "exit only" lane on the left and the left lane would have an option to exit onto Vineyard Boulevard. Vehicles entering H-1 from the 2-lane on-ramp at Lunalilo Street would merge into one-lane when the lane is added on the left and would merge with H-1 after the off-ramp and therefore not be able to access the Vineyard Boulevard off-ramp. (2) Additional right-of-way may be required to accommodate the column placement on the makai side of the H-1 Freeway at Lunalilo Street and Ward Avenue. (3) Relocate the pedestrian bridge.	Eliminate the weaving section between Lunalilo Street and Vineyard Boulevard, reducing congestion on H-1. However, vehicles from the Lunalilo Street on-ramp would be unable to utilize the Vineyard Boulevard off-ramp but could continue on Lunalilo street to use Ward Avenue or Queen Emma Street to access Vineyard Boulevard.	$119.0
	R2	H-1 Westbound Lunalilo Street On-Ramp	The on-ramp is closed in the AM peak period due to the weaving section created by its close proximity to the Vineyard Boulevard off-ramp.	If Project R1 is implemented, provide two lanes on the Lunalilo Street on-ramp which would merge into a single lane before merging with H-1 after the Vineyard Boulevard off-ramp. Vehicles would be allowed to access H-1 but not Vineyard Boulevard.	Opening the Lunalilo Street on-ramp and providing two lanes would decrease traffic volumes on the Punahou Street and Alexander Street on-ramps. Traffic volumes around the Vineyard Boulevard/Punchbowl Street and Vineyard Boulevard/Pali Highway intersections would be greatly reduced as vehicles uses these intersections to access H-1 and Pali Highway when the Lunalilo Street on-ramp is closed.	$9.0
	R3	Lunalilo Street and Pensacola Street Intersection	With the implementation of Projects R2, R4, and R5, intersection improvements are recommended to accommodate the resulting shift in traffic flows.	Provide one left-turn lane, a shared through/left-turn lane, a through lane, and a free right-turn lane on the westbound approach (split phasing) and a through lane, a shared through/right-turn lane, and a right-turn lane with no right-turn on red on the southbound approach (split phasing) to the Lunalilo Street and Pensacola Street intersection.	Accommodate shift in traffic patterns caused by nearby improvements.	$0.7
	R4	Pensacola Street from Piikoi Street (north of Wilder Avenue) to Lunalilo Street	Limited access to areas north of H-1. Vehicles from south of H-1 must utilize Piikoi Street or Ke'eaumoku Street and vehicles from north of H-1 but west of Piikoi Street must make a left-turn from Wilder Avenue to Piikoi Street to access the school to the north.	(1) Provide one-lane in the northbound direction and two lanes in the southbound direction on Pensacola Street from Piikoi Street to Lunalilo Street. (2) Provide signage and signals to indicate two-way operation. Reorient the southbound facing parking along the east curb of Pensacola Street to a northbound direction.	Traffic from westbound H-1 could utilize Pensacola Street rather than Piikoi Street to access Wilder Avenue. This improvement would also provide easier access to the school to the north.	$0.2
	R5	Pensacola Street and Wilder Avenue/Piikoi Street intersections	With the implementation of Project R4 these intersections would require modifications to accommodate two-way traffic on Pensacola Street.	(1) Provide the following lane configurations at the Wilder Avenue and Pensacola Street intersection: Northbound - all shared (permitted phasing). Southbound - shared through/left-turn lane and shared through/right-turn lane (permitted phasing). Eastbound - shared through/left-turn lane and a right-turn lane (split phasing). Westbound - one left-turn lane, a shared through/left-turn lane, and a right-turn lane (split phasing). (2) Provide an uncontrolled through lane in the northbound and southbound directions and stop-controlled left- and right-turn lanes on the westbound approach to the Piikoi Street and Pensacola Street intersection. (3) Restrict parking in the non-functional westbound right-turn lane to provide a westbound right-turn lane.	Accommodate two-way traffic on Pensacola Street and provide easier access to the school to the north.	$0.5
	R6	H-1 Westbound off-ramp at Lunalilo Street	Proximity of off-ramp to Punahou Street on-ramp creates a short weaving section, causing congestion on H-1.	Shift off-ramp westward closer to Lihaliha Street to lengthen weaving section with Punahou Street.	Alleviate congestion on H-1.	$4.9
	R7	H-1 Eastbound On-Ramp at Pali Highway	The AM peak 2-hour period traffic volume (roughly 3,800 vehicles) exceeds the capacity (roughly 3,000 vehicles) of the existing one-lane on-ramp.	(1) Widen on-ramp to provide two lanes onto H-1. The existing 3-lane auxiliary segment would need to be restriped to provide one trap lane onto the H-1 on-ramp, one trap lane onto the Punchbowl Street off-ramp, and one lane with access to both. (2) A physical barrier would be provided to restrict H-1 off-ramp traffic to the Punchbowl Street off-ramp.	Decrease queuing on Pali Highway and increase traffic volume on eastbound H-1 between Pali Highway on-ramp and Kinau Street off-ramp.	$4.5
	R8	H-1 Eastbound mainline from Pali Highway On-Ramp to Kinau Street Off-Ramp (weave section)	Weaving section is overcapacity, resulting in vehicle queues on H-1 that extend west of Pali Highway.	Widen section of H-1 to 5 lanes to provide additional capacity and to accommodate the new two-lane on-ramp from Pali Highway.	Decrease queuing on H-1 west of Pali Highway and direct vehicles onto the widened Kinau Street off-ramp (Project 3).	$12.5
	R9	H-1 Eastbound Off-Ramp at Kinau Street	The AM peak period traffic volume (roughly 2,700 vehicles) is near the capacity (roughly 3,000 vehicles) of the existing one-lane on-ramp.	Widen off-ramp to provide two lanes from H-1. This improvement is also needed to accommodate the additional H-1 lane from Project R8.	This improvement, along with Projects R7 and R8, widen the existing weaving section between the Pali Highway on-ramp and the Kinau Street off-ramp from one to two lanes, increasing the capacity of the entire section.	$10.1
	R10	H-1 Eastbound off-ramp Kinau Street and Kinau Street/Ward Avenue Intersections	Vehicles from the uncontrolled eastbound through movement that wish to make a left-turn onto Ward Avenue must cross vehicles from the off-ramp that wish to make a right-turn onto Ward Avenue, effectively creating a weaving section. There is also a high speed differential between the two movements, making this weave very difficult.	(1) Install a physical barrier to eliminate the stop-controlled eastbound through movement while providing side-street stop-control on the existing uncontrolled eastbound through lane. (2) Restripe the eastbound approach to the Kinau Street/Ward Avenue intersection to provide a shared through/left-turn lane, two through lanes, and a right-turn lane.	Improve operations at the intersections and eliminate weaving.	$0.1
	R11	Kinau Street between Ward Avenue and Piikoi Street	Kinau Street provides two lanes in the eastbound direction with parking on both sides. This section could be widened to alleviate congestion on H-1 and King Street.	Implement peak hour parking restrictions and "Anti-Gridlock Zone" signs on one side of Kinau Street between Ward Avenue and Piikoi Street to provide 3 lanes in the eastbound direction.	This improvement, along with Projects R7 R8 R9, R10, would allow vehicles to exit H-1 prior to the Vineyard Boulevard on-ramp and utilize Kinau Street to distribute to local arterials such as Pensacola Street and Piikoi Street. This would improve operations at the merge point and alleviate congestion on H-1.	$0.1
	R12	Piikoi Street and Kinau Street/Lunalilo Street Intersections	With the implementation of projects R7, R8, R9, R10 and R11, the traffic volumes on Kinau Street would increase. To accommodate the additional traffic, improvements would need to be made at the Piikoi Street and Kinau Street/Lunalilo Street intersections to distribute traffic through the roadway network.	(1) Provide two left-turn lanes, two through lanes, and a free right-turn lane to the H-1 eastbound on-ramp on the northbound approach to the Piikoi Street and Lunalilo Street intersection (split phasing). Provide proper signage to direct motorists wishing to make a left-turn onto Pensacola Street to use the left-most left-turn lane, motorists wishing to make a right-turn onto Pensacola Street to use the right-most left-turn lane, and vehicles wishing to access H-1 to use either left-turn lane. Also provide two through lanes and a free right-turn lane onto Piikoi Street on the westbound approach (split phasing). (2) Remove approximately 3 parking spaces (for a total ~ 150' of red curb) from the south curb of the east leg of the intersection of Piikoi St & Kinau Ave in order to allow a safe merging of the eastbound through vehicles due to curb side parking. (The peak hour parking restriction does not apply east of Piikoi St.)	Traffic from the west could utilize Kinau Street to access the H-1 eastbound on-ramp at Piikoi Street and the area north of H-1.	$0.7

TABLE 1

RECOMMENDED REGIONAL AND LOCAL ROADWAY IMPROVEMENT PLAN FOR THE HONOLULU AREA RAPID TRANSIT STUDY

Types	Project #	Facility	Need for Improvements	Project Description	Benefits	Cost Estimates (Millions of Year 2008 Dollar) [a]
Local Circulation Improvements in the Vicinity of Future Guideway Stations	L1	Circulatory roadways in Ward neighborhood [b]	Difficult circulation in the Ward neighborhood due to limited connectivity and industrial-oriented environment	(1) Improve the landscape and install sidewalks on Queen Street, Kawaiahao Street and Waimanu Street between Ward Avenue and Kamakee Street	Facilitate local circulation and land use interactions.	$1.6
				(2) Improve the landscape and install sidewalks on Hopaka Street and Kona Street from Kamakee Street to Piikoi Street		$3.0
				(3) Extend Halekauwila Street from Ward Avenue to Kamakee Street to provide direct access from Ward neighborhood to the Civic Center area		$17.8
				(4) Extension of Cummins Street from Queen Street to Ala Moana Boulevard		$15.9
				(5) Extension of Pohukaina Street from Kamani Street to Ward Avenue		$5.1
				(6) Extension of Ahui Street from Pohukaina Street to Ala Moana Boulevard		$11.4
				(7) Extension of Queen Lane from Ala Moana Boulevard to Waimanu Street		$16.5
				subtotal (1) thru (7)	*subtotal (a) thru (g)*	$71.2
	L2	Ward Avenue/Ala Moana intersection	Heavy southbound right-turn movement without a dedicated right turn lane. One of the two southbound thru lanes is underutilized.	Restripe the southbound approach of Ward Avenue from one shared thru/right lane, one shared thru-left lane and one exclusive left turn lane to one exclusive right turn lane, one shared thru/left lane and one exclusive left turn lane. Modify the signal timing and phasing to increase green time for the northbound approach.	Improved intersection operating conditions, with acceptable LOS D or better during the peak hours.	$0.52
	L3	Ward Avenue/Queen Street intersection	Heavy right turn from Queen Street to Ward Avenue during the PM peak hour	(1) Restripe both approaches of Queen Street from a single lane to a right turn lane and a shared thru-left turn lane. (2) Remove parking on the mauka side of Queen Street east of Ward Avenue (approximately five 90-degree parking spaces); and on the makai side of Queen Street west of Ward Avenue (approximately 2 curb parking spaces).	Improved intersection operating conditions, with acceptable LOS D or better during the peak hours.	$0.04
	L4	Kamakee Street/Ala Moana Boulevard intersection	Expected cumulative traffic increase from Kamakee Street to Ala Moana Boulevard due to the proposed Kaka'ako Station and adjacent redevelopment	Modify existing signal timing plan to allocate more green time from Ala Moana Boulevard to Kamakee Street.	Improved intersection operating conditions, with acceptable LOS D or better during the peak hours.	$0.004
	L5	Cooke Street/Halekauwila Street intersection	Right turn volumes from Halekauwila to Cooke Street are expected to increase due to expected traffic exiting future development. Restriping to provide additional turn lanes would result in multiple lanes in all approaches; which makes traffic control less efficient.	Reconfigure the stop controlled intersection to a single lane roundabout with landscaped central island and splitter island. Right-of-way acquisition would be required	Improved intersection operating conditions, with acceptable LOS D or better during the peak hours.	$2.9
	L6	Kona Street/Ke'eaumoku Street intersection	Conflict between vehicles and pedestrian volumes crossing Kona Street; Poor intersection level of service.	Proposed Improvement: Install new signals for traffic and pedestrians. [c]	Signal control would provide enhanced pedestrians access to the proposed guideway station and the shopping centers. Intersection level of service would be improved to LOS D or better during both peak hours.	$0.7
	L7	Kona Street/Kaheka Street intersection	Insufficient control for forecasted high vehicular traffic and pedestrians to the proposed guideway station and Ala Moana Center	Install new signals for traffic and pedestrians.	Signal control would provide enhanced pedestrians access to the proposed guideway station and the shopping centers. Intersection level of service would be improved to LOS D or better during both peak hours.	$0.7
	L8	Kapi'olani Boulevard/Ward Avenue intersection	Insufficient capacity for existing and future traffic volumes.	(1) Widen the makai bound approach of Ward Avenue to add a right turn lane to facilitate the right turn vehicles from Ward Avenue to Kapi'olani Ews bound. (2) Remove the zoned contra flow operation at this intersection during the PM peak hour (i.e., current PM contra flow operation on Kapi'olani Boulevard ends between Cooke Street and South Street. With this improvement, contra flow would end between Kamakee Street and Ward Avenue). Left turn from Kapiolani Boulevard to Ward Avenue would remain restricted.	Improved intersection operating conditions from LOS F in both peak hours to LOS D in the AM Peak hour and LOS E in the PM Peak Hour.	$2.2
					2030 with Recommended Plan Total Cost Estimates [a]	**$239.1**
Alternative Plan	A1	H-1 Westbound Braiding Off-Ramp at Vineyard Boulevard	A short weaving section exists between the Lunalilo Street on-ramp and the Vineyard Boulevard off-ramp. If the Lunalilo Street on-ramp provided access to H-1 in the AM peak period, this weaving section would need to be eliminated to reduce congestion on H-1.	(1) Construct a flyover from H-1 to the existing Vineyard Boulevard off-ramp (Ramp Braiding). (2) Modify existing single-lane on-ramp for the Lunalilo Street on-ramp due to the required placement of pillars for the new Vineyard Boulevard off-ramp.	Eliminate the weaving section between Lunalilo Street and Vineyard Boulevard, reducing congestion on H-1. However, vehicles from the Lunalilo Street on-ramp would be unable to utilize the Vineyard Boulevard off-ramp.	$101.3
	A6	Kona Street/Ke'eaumoku Street intersection	Conflict between vehicles and pedestrians volumes crossing Kona Street. Poor intersection level of service.	Alternative Improvement: Install new signals for traffic management. Restripe southbound approach to allow 1 right turn only lane, 1 shared right-turn and thru lane, and 1 shared thru and left turn lane. Operate the approaches of Ke'eaumoku Street in split phases.	Signal control would provide enhanced pedestrians access to the proposed guideway station and the shopping centers. Intersection level of service would be improved to LOS D or better during both peak hours.	$0.7
					2030 with Alternative Plan Total Cost Estimates (including A1, A6, R2 ~ R12, L1 ~ L5) [a]:	**$305.9**

Note:
[a] These estimates do not include costs associated with right-of-way acquisition.
[b] The concept improvements were developed based on review of two documents: (1) *Draft Mauka Area Plan - Kaka'ako Hawaii Community Development District, Honolulu, Hawaii, Hawaii Community Development Authority (HCDA), May 2007, and (2) Ward Neighborhood Master Plan, General Growth Properties, Inc., (GGP), April 16, 2008*
[c] Signalization of Kona Street and Ke'eaumoku Street intersection would be consistent with the traffic mitigation measure proposed at this location in the *Honolulu Capacity Transit Corridor Project - Draft Environmental Impact Statement/Section 4(f) Evaluation, November 2008, City and County of Honolulu.*
Source: Fehr & Peers, 2009.

- Pi'ikoi Street and Kinau Street/Lunalilo Street Intersections (Project R12): Widening the Kinau off-ramp from one to two lanes would allow Kinau to move more traffic. To accommodate the additional traffic, improvements would need to be made at the Pi'ikoi Street and Kinau Street/Lunalilo Street intersections to distribute traffic through the roadway network. The plan recommends provision of two left-turn lanes, two through lanes, and a free right-turn lane to the H-1 eastbound on-ramp on the northbound approach to the Pi'ikoi Street and Lunalilo Street intersection (split phasing). The plan also recommends providing proper signage to direct motorists wishing to make a left turn onto Pensacola Street to use the left-most left-turn lane, motorists wishing to make a right turn onto Pensacola Street to use the right-most left-turn lane, and vehicles wishing to access H-1 to use either left-turn lane. Also two through lanes and a free right-turn lane onto Pi'ikoi Street on the westbound approach (split phasing) should be provided, the removal of parking (three spaces) from the south curb of the east leg of the intersection of Pi'ikoi Street/Kinau Avenue is recommended in order to allow a safe merging of the eastbound through vehicles due to curb side parking. (The peak hour parking restriction does not apply east of Pi'ikoi Street).

Projects to Improve Local Circulation near Future Guideway Transit Stations

Specific recommendations were developed to improve access to future guideway station areas. Figure 12 depicts the concepts for projects L1 through L8.

- Circulatory Roadways in Ward Neighborhood (Project L1): Circulation in the Ward neighborhood is difficult as a result of limited connectivity and the industrial-oriented environment. Seven locations were identified as one package for potential roadway extensions and/or landscape improvement opportunities, including: (1) improving the landscape and installing sidewalks on Queen Street, Kawaiahao Street and Waimanu Street between Ward Avenue and Kamakee Street;(2) improving the landscape and installing sidewalks on Hopaka Street and Kona Street from Kamakee Street to Pi'ikoi Street; (3) extending Halekauwila Street from Ward Avenue to Kamakee Street to provide direct access from Ward neighborhood to the Civic Center area; (4) extending Cummins Street from Queen Street to Ala Moana Boulevard; (5) extending Pohukaina Street from Kamani Street to Ward Avenue; (6) extending Ahui Street from Pohukaina Street to Ala Moana Boulevard; and (7) extending Queen Lane from Ala Moana Boulevard to Waimanu Street.

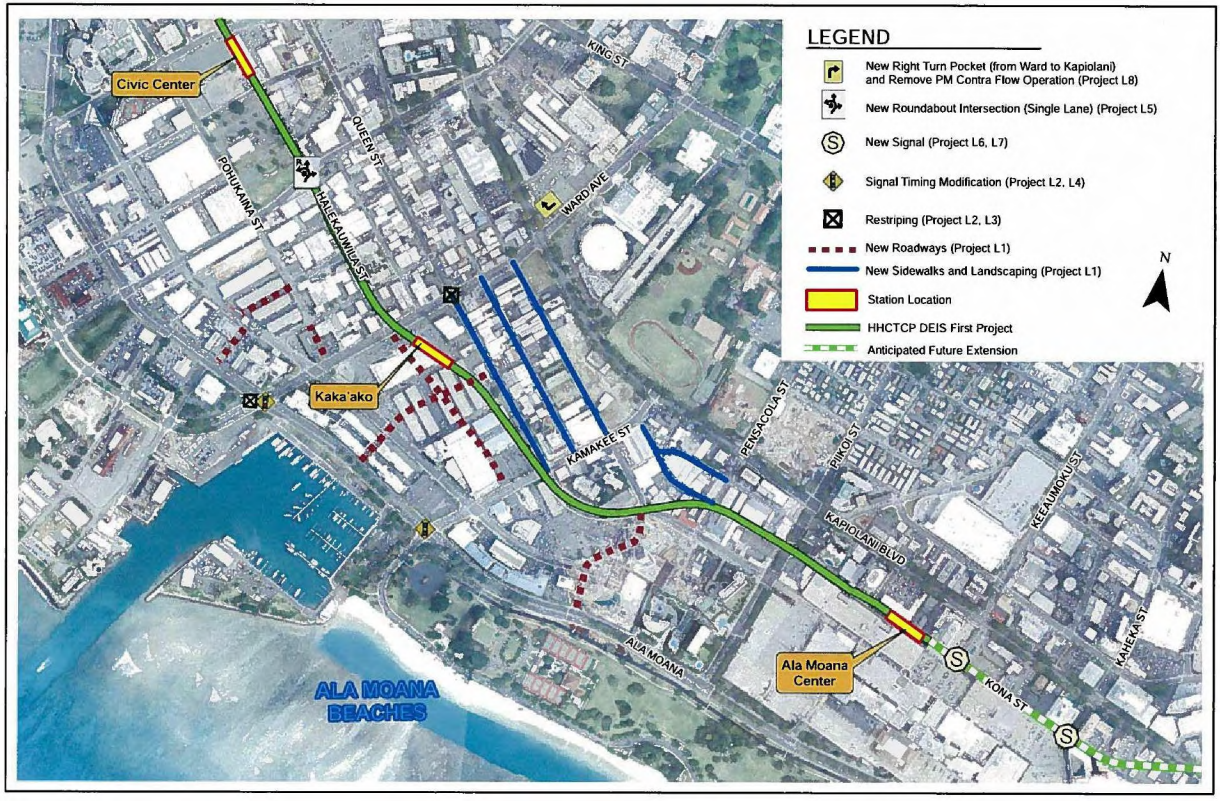
- Ward Avenue at Ala Moana (Project L2): Restripe the southbound approach of Ward Avenue from one shared through/right lane, one shared through/left lane and one exclusive left-turn lane to one exclusive right-turn lane, one shared through/left lane and one exclusive left-turn lane. Modify the signal timing and phasing to increase green time for the northbound approach.

- Ward Avenue at Queen Street (Project L3): Restripe both approaches of Queen Street from a single lane to a right-turn lane and a shared through/left-turn lane.

- Kamakee Street at Ala Moana Boulevard (Project L4): Modify existing signal timing plan to allocate more green time from Ala Moana Boulevard to Kamakee Street.

- Cooke Street at Halekauwila Street (Project L5): Reconfigure the stop-controlled intersection to a single lane roundabout, with landscaped central island and splitter island. Right-of-way acquisition would be required.

- Kona Street at Ke'eaumoku Street and Kona Street at Kaheka Street (Projects L6 and L7): To accommodate future cumulative traffic increases, the plan recommends signal installation at these two locations.



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December 2009

LOCAL CIRCULATION IMPROVEMENT PLAN
NEAR FUTURE GUIDEWAY TRANSIT STATIONS
FIGURE 12

- Kapi'olani Boulevard/Ward Avenue Intersection (Project L8): Widen the makai bound approach of Ward Avenue to add a right-turn lane to facilitate the right-turning vehicles from Ward Avenue to Ewa-bound Kapi'olani. Remove the coned contraflow operation at this intersection during the PM peak hour (i.e., current PM contraflow operation on Kapi'olani Boulevard ends between Cooke Street and South Street, but with this improvement, contraflow would end between Kamakee Street and Ward Avenue); the left turn from Kapi'olani Boulevard to Ward Avenue would remain restricted.

BENEFITS OF THE RECOMMENDED PLAN

The projects contained in the Recommended Plan would enhance performance of both existing and future base conditions, as calculated by the performance measures described below.

VMT, VHT, VHD

Tables 4 and 5 summarize the systemwide travel statistics results for existing, 2030 baseline and 2030 with the Recommended Plan. Figure 13 provides bar charts to illustrate these systemwide performance results.

As shown in the tables and figure, the Recommended Plan would increase system efficiency and carry additional 7,000 and 5,000 vehicles to their destinations in the study area and other communities on the island (rather than queuing on the freeway or parking off) during the AM and PM peak hour, respectively.

With the Recommended Plan, total VMT would increase by 10 percent from 2030 baseline as a result of higher system efficiency. Total VHT would decrease by 1% during the AM peak hour and 10% during the PM peak hour. But delay per vehicle would decrease by 18% in the AM peak hour and 17% in the PM peak hour. VHD/VMT ratio is another indicator of the congestion level on the roads. Under existing conditions, for every mile driven in the study area, the delay would be roughly four minutes because of congestion. For example, to travel from future Kaka'ako Station to the Makiki communities (about two miles), may take less than five to 10 minutes during the off-peak period. With congestion, a driver may experience an additional delay of up to 15 to 20 minutes. With the Recommended Plan, the average travel time savings per mile driven is estimated at a half minute in the AM peak hour and one to two minutes in the PM peak hour.

Travel Time

Tables 6 and 7 shows the peak hour travel time results for the H-1 Freeway and the communities that would be affected by the Recommended Plan.

In the AM peak hour, with the Recommended Plan, the Lunalilo on-ramp would resume access to the H-1 Freeway. Elimination of the weave section between the Lunalilo on-ramp and the Vineyard Boulevard off-ramp would improve the traffic flow on the H-1 Freeway Ewa-bound lanes. The average travel time savings are estimated to be from one minute for traffic passing by the study area up to eight minutes for traffic from University-Manoa to City Hall. After the re-opening of the Lunalilo on-ramp as proposed in the Recommended Plan, Pi'ikoi would become a locally favored route to the Lunalilo on-ramp and allow easy access from the Kaka'ako and Ward neighborhoods. Therefore, additional traffic on Pi'ikoi may result in a slight increase in average travel time on Pi'ikoi Street; however, resuming easy access to Ewa-bound H-1 would benefit the local residents.

TABLE 4

SYSTEMWIDE PERFORMANCE - AM PEAK HOUR (6:30-7:30 AM)

Performance	Existing (2008) *(w/ closure of H-1 WB on-ramp w/o Pensacola*)*	2030 Base *(w/ closure of H-1 WB on-ramp w/o Pensacola*)*	2030 with Recommended Plan *(left hand off-ramp from H-1 to Vineyard)***	2030 with Alternative Plan *(right hand flyover off-ramp from H-1 to Vineyard)****
Number of Vehicles arrived destinations in the study area or exited the study area	61,200	63,700	70,500	69,400
VMT [mi]	121,500	127,200	140,100	138,600
VHT [h]	7,500	10,100	10,100	10,200
Average Speed [mph]	16.3	12.6	14.0	13.6
VHD [h]	4,400	6,900	6,400	6,697
Average Delay per Vehicle [s]	225	322	280	292
VHD/VMT (min/mile)	2.2	3.3	2.76	2.90

*Traffic entering the H-1 westbound on-ramp at Pensacola Street is restricted to exit Vineyard Boulevard only.

**Traffic entering the H-1 westbound on-ramp at Pensacola Street would be allowed to access H-1 Freeway; however would not have access to Vineyard Boulevard.

***Traffic entering the H-1 westbound on-ramp at Pensacola Street would be able to use the H-1 mainline facility; however would not be allowed to exit Vineyard Boulevard.

Source: Fehr & Peers (VISSIM Traffic Simulation Peak Hour Model)

TABLE 5
SYSTEMWIDE PERFORMANCE - PM PEAK HOUR (5:00-6:00 PM)

Performance	Existing (2008)	2030 Base	2030 with Recommended Plan *(left-hand off-ramp from H-1 to Vineyard)**	2030 with Alternative Plan *(right hand flyover off-ramp from H-1 to Vineyard)***
Number of Vehicles arrived destinations in the study area or exited the study area	69,700	63,800	68,900	66,600
VMT [mi]	114,700	110,100	121,000	118,100
VHT [h]	10,600	15,600	13,900	14,200
Average Speed [mph]	11	7.1	8.7	8.3
VHD [h]	7,700	12,700	10,800	11,200
Average Delay per Vehicle [s]	336.0	557	459	483
VHD/VMT (min/mile)	4.01	7.00	5.39	5.70

* Traffic entering the H-1 westbound on-ramp at Pensacola Street would be allowed to access H-1 Freeway; however would not have access to Vineyard Boulevard.

** Traffic entering the H-1 westbound on-ramp at Pensacola Street would be able to use the H-1 mainline facility; however would not be allowed to exit Vineyard Boulevard.

Source: Fehr & Peers (VISSIM Traffic Simulation Peak Hour Model)

TABLE 6

AVERAGE TRAVEL TIME - AM PEAK HOUR (6:30-7:30 AM)

Route/Travel Time (mm:ss)	Distance (mile)	Existing (2008) *(w/ closure of H-1 WB on-ramp w/o Pensacola*)*	2030 Base *(w/ closure of H-1 WB on-ramp w/o Pensacola*)*	2030 with Recommended Plan *(left hand-off-ramp from H-1 to Vineyard)***	2030 with Alternative Plan *(right hand flyover off-ramp from H-1 to Vineyard)****
1 H-1 WB 5th to Nuuanu	4.0	15	15	13.5	14
2 H-1 WB Kapahulu to Vineyard	3.4	13	13	12	12
3 H-1 EB Nuuanu to 5th St	3.9	10.5	15.5	17 [a]	16.5 [a]
4 Pi'ikoi from Ala Moana to H-1 WB Lunalilo on-ramp	2.3	8	13.5	18 [b]	23 [b]
5 Pali Hwy SB from Wyllie to Vineyard	1.7	13.5	10	8	12
6 University to H1 WB at Nuuanu	3.0	13	11.5	10	11.5
7 University to Vineyard at Nuuanu	2.9	12	12	10.5	12
8 University to City Hall	2.8	26.5	18	15	15.5
9 Pensacola at Wilder to H1 WB at Nuuanu	1.5	3.5	7	3	4
10 Punahou at Wilder to H1 WB Nuuanu	2.1	6	5	3.5	5
11 Punahou at Wilder to Vineyard at Nuuanu	1.8	6.5	5.5	4.5	5
12 Metcalf at Wilder to H1 WB at Nuuanu	2.4	17	15	14.5	20.5 [c]
13 Metcalf at Wilder to Ala Moana Center	1.5	8	7	6.5	6.5

*Traffic entering the H-1 westbound on-ramp at Pensacola Street is restricted to exit Vineyard Boulevard only.

**Traffic entering the H-1 westbound on-ramp at Pensacola Street would be allowed to access H-1 Freeway; however would not have access to Vineyard Boulevard.

***Traffic entering the H-1 westbound on-ramp at Pensacola Street would be able to use the H-1 mainline facility; however would not be allowed to exit Vineyard Boulevard.

[a] Proposed improvements to the widen the H-1 Koko bound mainline off-ramps from the Pali Highway to Kinau Street would allow H-1 to enhance regional access to and from the study area. This would increase traffic volumes on the H-1 Freeway mainlines, and therefore may result in average travel time increase on the H-1 Freeway for traffic bypassing the study area.

[b] Access from Lunalilo on-ramp to H-1 Ewa-bound is closed under existing AM peak period and is assumed remain closed in 2030 Base condition. After re-opening of the Lunalilo on-ramp as proposed in the Recommended Plan, Pi'ikoi would become a locally favored route to the Lunalilo on-ramp and allow easy access from Kaka'ako and Ward neighborhood. Therefore, additional traffic increase on Pi'ikoi may result in a slight increase in average travel time on Pi'ikoi Street; however, resuming easy access to Ewa-bound H-1 would benefit the local residents.

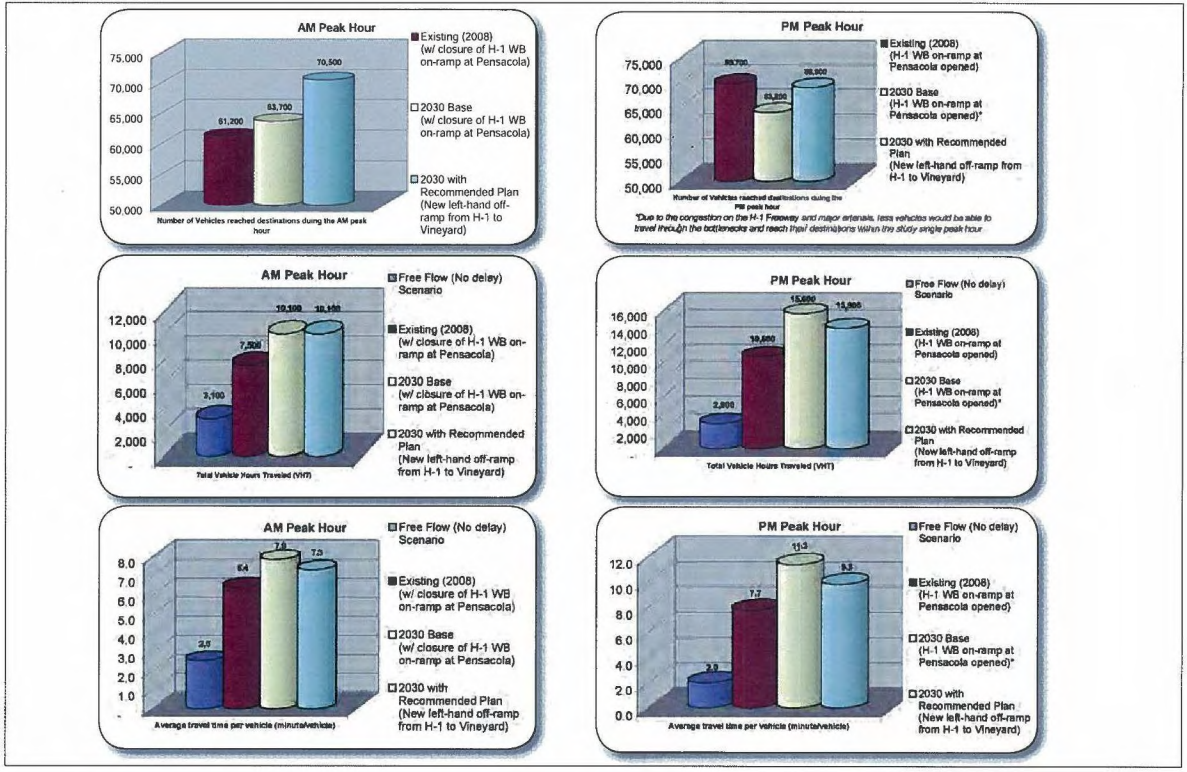
[c] With the Alternative Plan, a new right-hand off-ramp to Vineyard Boulevard near Pensacola Street would introduce a new weave section between existing Lunalilo on-ramp and the Ewa-bound off-ramp on Lunalilo Street at Ke'eaumoku Street. This weave section may create some queuing on the H-1 Ewa-bound lanes that affect the nearby ramp access at Alexander Street and Metcalf Street.

Source: Fehr & Peers

TABLE 7
TRAVEL TIME - PM PEAK HOUR (5:00-6:00 PM)

Route/Travel Time (minutes)	Distance (mile)	Existing (2008)	2030 Base	2030 with Recommended Plan *(left hand off-ramp from H-1 to Vineyard)***	2030 with Alternative Plan *(right hand flyover off-ramp from H-1 to Vineyard)****
1 H-1 WB 5th to Nuuanu	4.0	9	14	10	10
2 H-1 WB Kapahulu to Vineyard	3.4	7	13	9.5	9
3 H-1 EB Nuuanu to 5th St	3.9	11	9	8.5	8.5
4 Beretania WB University to Pali	2.8	7	12	9	8
5 Pi'ikoi from Ala Moana to H-1 WB Lunalilo on-ramp	2.3	21	22.5	8.5	19.5
6 Pali Hwy SB from Wyllie to Vineyard	1.7	9	14	8	9
7 University to H1 WB at Nuuanu	3.0	9	12	9.5	9.5
8 University to City Hall	2.8	4	17	11	11
9 Punahou at Wilder to H1 WB Nuuanu	2.1	5	6.5	5.5	6
10 Punahou at Wilder to Vineyard at Nuuanu	1.8	3.5	7	5	5
11 Punahou at Wilder to Kaka'ako Station	1.8	20	13	6.5	13
12 Metcalf at Wilder to H1 WB at Nuuanu	2.4	9.5	16	8.5	10.5
13 Metcalf at Wilder to Kaka'ako Station	2.2	14	21	10.5	17

*Traffic entering the H-1 westbound on-ramp at Pensacola Street would be allowed to access H-1 Freeway; however would not have access to Vineyard Boulevard.
**Traffic entering the H-1 westbound on-ramp at Pensacola Street would be able to use the H-1 mainline facility; however would not be allowed to exit Vineyard Boulevard.
Source: Fehr & Peers



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SYSTEMWIDE TRAVEL STATISTICS FOR THE RECOMMENDED PLAN

FIGURE 13

Proposed improvements to the widen the H-1 Koko Head-bound mainline off-ramps from the Pali Highway to Kinau Street would allow H-1 to enhance regional access to and from the study area. This would increase traffic volumes on the H-1 Freeway mainlines, and therefore may result in an average travel time increase on the H-1 Freeway for Koko Head-bound traffic bypassing the study area

In the PM peak hour, the Lunalilo on-ramp to the H-1 access would remain open under future conditions. The recommendations would improve travel time on the freeway and in particular, the access to the Lunalilo ramp from Pi'ikoi Street. Elimination of the weave section between the Lunalilo on-ramp and Vineyard off-ramp would significantly reduce the travel time from one minute to almost 15 minutes for various destinations in the Kaka'ako area.

Figure 14A-B depicts the key travel time study routes and the estimated AM and PM peak hour travel time changes with the Recommended Plan.

Ramp Operating Conditions

Tables 8 and 9 present the operating conditions of the freeway ramps that would be affected by the recommendations. In the AM peak hour, re-opening access from Lunalilo Street to H-1 with two entry lanes from Lunalilo Street would facilitate over 900 vehicles leaving the study area for H-1 Ewa-bound, but still carry almost the same number of vehicles to Vineyard Boulevard with good operating conditions on both the Lunalilo on-ramp and Vineyard off-ramp. Elimination of the weave section between the Lunalilo on-ramp and Vineyard off-ramp would also improve the travel speed and throughput at the upstream on-ramps at Punahou Street and Alexander Street/Metcalf Street. Widening the H-1 Koko Head-bound mainlines and Kinau off-ramp would allow 500 to 600 more vehicles to enter the study area. Similar trends are expected for the PM conditions.

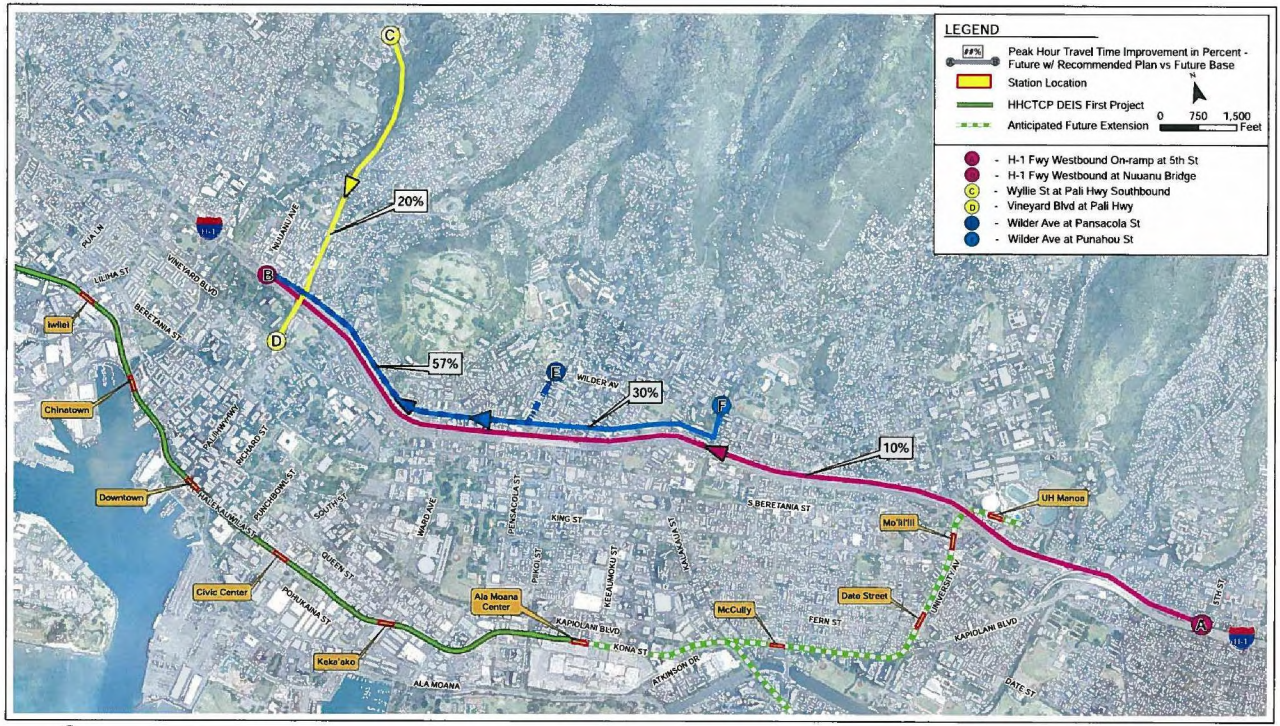
Station Area Traffic Conditions

Analysis of future intersection traffic conditions with the implementation of all eight local circulation projects, as shown in Table 10, indicates that recommended improvements would improve the traffic operation conditions at the hot spot intersections over the future base conditions. Figure 15 depicts the station area traffic operating LOS conditions with the recommended plan.

COST ESTIMATES

The improvements recommended in this study can be implemented in two phases. Local circulation improvements in the vicinity of future guideway stations can be implemented within three to five years to produce an immediate benefit to the existing transportation system. This schedule would also be in line with planned the construction of the three future guideway stations and alignment in the study area. Regional roadway improvements to enhance H-1 Freeway access can be implemented within ten years or sooner if funding is available. Funding for the planning and implementation of each roadway improvement project can possibly thought through various resources, including the City's Capital Improvement Program (CIP), the State's TIP, and Federal funding.

Order-of-magnitude cost estimates were prepared for each project and are summarized in Table 11. The estimated construction cost for the recommended plan is approximately $239 million. Right-of-way acquisition was not included in these estimates. The first two regional improvement projects (R1 and R2) are major capital improvement projects that together would contribute half of the total cost ($128 million). However, the combination of R1 and R1 would greatly improve the traffic operations on the H-1 segment between the Lunalilo on-ramp and Vineyard off-ramp. In particular, re-opening of the Lunalilo on-ramp would improve local circulation on both sides of the H-1 Freeway and reduce neighborhood cut-through traffic. Local circulation improvements account for approximately one-third of the Plan ($76.9 million).



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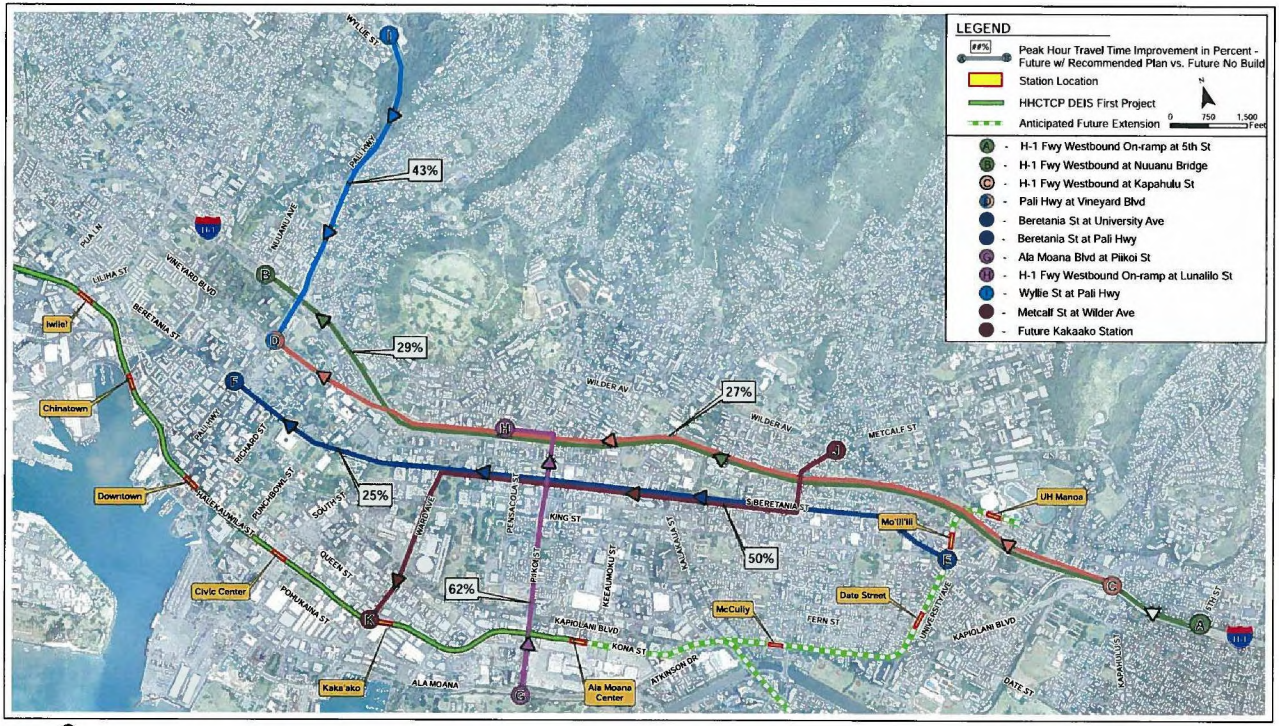
AM PEAK HOUR TRAVEL TIME DECREASE
WITH RECOMMENDED PLAN
FIGURE 14A



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PM PEAK HOUR TRAVEL TIME DECREASE WITH RECOMMENDED PLAN

FIGURE 14B

TABLE 8

SELECTED FREEWAY RAMP ANALYSIS - AM PEAK HOUR (6:30-7:30 AM)

H-1 Fwy Ramp Location	Evaluation	Existing (2008) *(w/ closure of H-1 WB on-ramp w/o Pensacola*)*	2030 Base *(w/ closure of H-1 WB on-ramp w/o Pensacola*)*	2030 with Recommended Plan *(left-hand off-ramp from H-1 to Vineyard)***	2030 with Alternative Plan *(right hand flyover off-ramp from H-1 to Vineyard)****
WB off-ramp to Pali Hwy exit	Speed (mph)	39	18	31	47
	Volume (vph)	740	760	1,360	1,100
	LOS	E	F	F	C
WB on-ramp at Punchbowl St	Speed (mph)	24	11	23	24
	Volume (vph)	1,340	1,180	880	870
	LOS	F	F	E	E
WB off-ramp at Vineyard Blvd	Speed (mph)	33	30	43	34
	Volume (vph)	1,200 (single lane)	1,800 (single lane)	1,760 (two lanes)	2,270 (single lane)
	LOS	E	F	C	F
WB on-ramp w/o Pensacola St (as known as Lunalilo on-ramp)	Speed (mph)	**No Access to H-1**	**No Access to H-1**	25	26
	Volume (vph)			1,070 (two lanes merging into 1 lane)	940 (two lanes)
	LOS			D	E
WB off-ramp w/o Ke'eaumoku St	Speed (mph)	33	37	45	35
	Volume (vph)	840	580	360	340
	LOS	D	B	A	A
WB on-ramp at Punahou St	Speed (mph)	21	35	36	31
	Volume (vph)	1,100	910	1,010	1,080
	LOS	F	C	D	D
WB on-ramp at Alexander St/Metcalf St	Speed (mph)	5	6	9	5
	Volume (vph)	740	830	1,110	710
	LOS	F	F	F	F
EB on-ramp from Pali Hwy southbound	Speed (mph)	8	15	29	30
	Volume (vph)	1,140 (single lane)	1,360 (single lane)	1,710 (two lanes)	1,550 (two lanes)
	LOS	F	F	F	F
EB off-ramp at Kinau St	Speed (mph)	38	40	37	43
	Volume (vph)	760 (single lane)	970 (single lane)	1,510 (two lanes)	1,480 (two lanes)
	LOS	B	C	C	B
EB on-ramp from Ward Ave	Speed (mph)	34	9	32	29
	Volume (vph)	490	440	760	530
	LOS	B	F	C	B

*Traffic entering the H-1 westbound on-ramp at Pensacola Street is restricted to exit Vineyard Boulevard only.

**Traffic entering the H-1 westbound on-ramp at Pensacola Street would be allowed to access H-1 Freeway; however would not have access to Vineyard Boulevard.

***Traffic entering the H-1 westbound on-ramp at Pensacola Street would be able to use the H-1 mainline facility; however would not be allowed to exit Vineyard Boulevard.

Source: Fehr & Peers

TABLE 9
SELECTED FREEWAY RAMP ANALYSIS - PM PEAK HOUR (5:00-6:00 PM)

H-1 Ramp Location	Evaluation	Existing (2008)	2030 Base	2030 with Recommended Plan *(left-hand off-ramp from H-1 to Vineyard)***	2030 with Alternative Plan *(right hand flyover off-ramp from H-1 to Vineyard)****
WB off-ramp to Pali Hwy exit	Speed (mph)	31	28	30	30
	Volume (vph)	770	640	660	690
	LOS	C	C	C	C
WB on-ramp at Punchbowl St	Speed (mph)	25	24	23	27
	Volume (vph)	1,170	1,110	1,070	1,140
	LOS	F	F	F	F
WB off-ramp at Vineyard Blvd	Speed (mph)	49	46	52	53
	Volume (vph)	740 (single lane)	920 (single lane)	1,200 (two lanes)	1,220 (single lane)
	LOS	B	C	A	C
WB on-ramp w/o Pensacola St	Speed (mph)	6	7	21	7
	Volume (vph)	840 (single lane)	910 (single lane)	1,570 (two lanes merging into 1 lane)	830 (single lane)
	LOS	F	F	F	F
WB off-ramp w/o Ke'eaumoku St	Speed (mph)	16	23	41	35
	Volume (vph)	1,460	1,390	920	940
	LOS	F	F	C	C
WB on-ramp at Punahou St	Speed (mph)	29	31	38	35
	Volume (vph)	700	880	355	440
	LOS	C	D	A	B
WB on-ramp at Alexander St/Metcalf St	Speed (mph)	12	5	14	19
	Volume (vph)	930	760	832	920
	LOS	F	F	F	F
EB on-ramp from Pali Hwy southbound	Speed (mph)	5	4	14	19
	Volume (vph)	840	680 (single lane)	1,220 (two lanes)	1,190 (two lanes)
	LOS	F	F	F	F
EB off-ramp at Kinau St	Speed (mph)	36	6	27	8
	Volume (vph)	880 (single lane)	780 (single lane)	1,230 (two lanes)	1,260 (two lanes)
	LOS	C	F	F	F
EB on-ramp from Ward Ave	Speed (mph)	1.3	2.2	22	20
	Volume (vph)	280	270	460	480
	LOS	F	F	C	E

EB: Eastbound bound (or Koko Head-bound). WB: westbound (or makai-bound)

*Traffic entering the H-1 westbound on-ramp at Pensacola Street would be allowed to access H-1 Freeway; however would not have access to Vineyard Boulevard.

**Traffic entering the H-1 westbound on-ramp at Pensacola Street would be able to use the H-1 mainline facility; however would not be allowed to exit Vineyard Boulevard.

Source: Fehr & Peers

TABLE 10
STATION AREA PEAK HOUR INTERSECTION OPERATING CONDITIONS

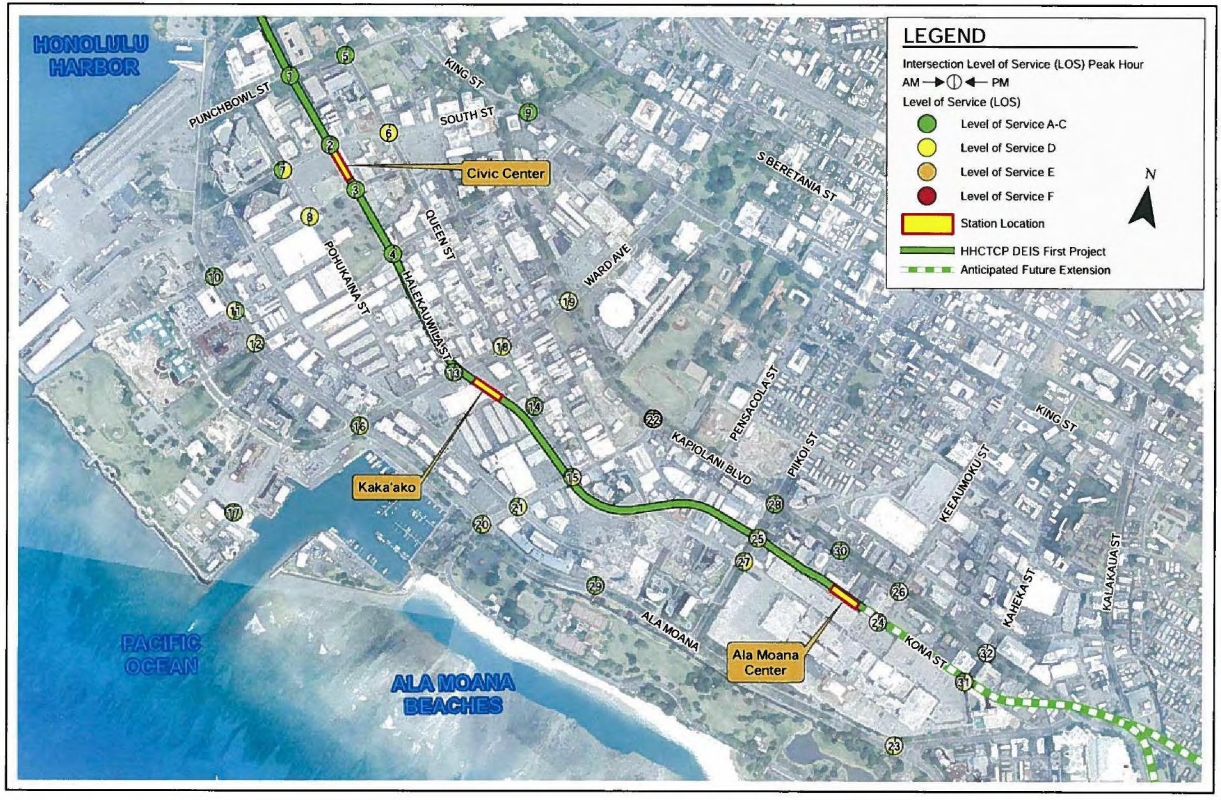
Intersection	Control	Peak Hour	Year 2008		2030 Base (ORTP)		2030 With Recommended Improvements [f]			2030 With Alternative Improvements [g]		
			Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Difference from Base	Delay (sec)	LOS	Difference from Base
Proposed Civic Center Station Area												
1 **Punchbowl St & Halekauwila St**	S	AM	15	B	15	B	16	B	1	15	B	0
		PM	18	B	22	C	22	C	0	22	C	0
2 **South St & Halekauwila St**	S	AM	23	C	24	C	25	C	1	24	C	0
		PM	28	C	28	C	28	C	0	28	C	0
3 **Halekauwila St & Keawe St**	AWSC	AM	11	B	16	C	18	C	2	16	C	0
		PM	11	B	17	C	16	C	-1	17	C	0
4 **Cooke St & Halekauwila St**	AWSC / Yield [b]	AM	13	B	21	C	10	B	-11	10	B	-11
		PM	14	B	47	E	11	B	-36	11	B	-36
5 **Punchbowl St & Queen St**	S	AM	16	B	27	C	25	C	-2	26	C	-1
		PM	21	C	29	C	27	C	-2	27	C	-2
6 **South St & Queen St**	S	AM	34	C	38	D	43	D	5	48	D	10
		PM	33	C	35	D	37	D	2	37	D	2
7 **South St & Pohukaina St**	S	AM	30	C	30	C	30	C	0	31	C	1
		PM	28	C	39	D	42	D	3	42	D	3
8 **Pohukaina St & Keawe St**	AWSC	AM	16	C	26	D	28	D	2	25	D	-1
		PM	14	B	26	D	32	D	6	31	D	5
9 **South King St & Kapiolani Blvd/ South St**	S	AM	21	C	25	C	26	C	1	25	C	0
		PM	27	C	31	C	30	C	-1	30	C	-1
10 **Ala Moana Blvd & Keawe St**	S	AM	22	C	29	C	31	C	2	31	C	2
		PM	16	B	22	C	22	C	0	22	C	0
11 **Ala Moana Blvd & Coral St**	S	AM	18	B	35	D	35	D	0	35	C	0
		PM	11	B	17	B	17	B	0	17	B	0
12 **Ala Moana Blvd & Cooke St**	S	AM	11	B	43	D	43	D	0	43	D	0
		PM	11	B	24	C	23	C	-1	23	C	-1
Proposed Kaka'ako Station Area												
13 **Ward Ave & Halekauwila St**	S	AM	5	A	5	A	5	A	0	5	A	0
		PM	11	B	11	B	12	B	1	12	B	1
14 **Queen St & Cummins St**	TWSC	AM	11	B	12	B	12	B	0	12	B	0
		PM	12	B	13	B	13	B	0	13	B	0
15 **Kamakee St & Queen St**	AWSC	AM	11	B	24	C	15	B	-9	27	D	3
		PM	18	C	28	D	31	D	3	31	D	3
16 **Ward Ave & Ala Moana Blvd**	S	AM	21	C	26	C	27	C	1	27	C	1
		PM	33	C	51	D	54	D	3	44	D	-7
17 **Ward Ave & Auahi St**	S	AM	16	B	21	C	20	C	-1	20	B	-1
		PM	19	B	23	C	24	C	1	24	C	1
18 **Ward Ave & Queen St**	S	AM	26	C	42	D	36	D	-6	37	D	-5
		PM	42	D	90	F	53	D	-37	43	D	-47
19 **Ward Ave & Kapiolani Blvd [a]**	S	AM	65	E	100	F	44	D	-56	44	D	-56
		PM	78	E	147	F	58	E	-89	57	E	-90
20 **Kamakee St & Ala Moana Blvd**	S	AM	16	B	26	C	23	C	-3	22	C	-4
		PM	28	C	91	F	50	D	-41	47	D	-44
21 **Kamakee St & Auahi St**	S	AM	9	A	9	A	9	A	0	10	A	1
		PM	12	B	34	C	35	D	1	37	D	3
22 **Kamakee St & Kapiolani Blvd [a]**	S	AM	6	A	7	A	6	A	-1	7	A	0
		PM	15	B	23	C	19	B	-4	19	B	-4

TABLE 10
STATION AREA PEAK HOUR INTERSECTION OPERATING CONDITIONS

	Intersection			Control	Peak Hour	Year 2008		2030 Base (ORTP)		2030 With Recommended Improvements [f]			2030 With Alternative Improvements [g]		
						Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Difference from Base	Delay (sec)	LOS	Difference from Base
Proposed Ala Moana Center Station Area															
23	Ala Moana Blvd	&	Atkinson Dr [a]	S	AM	37	D	53	D	44	D	-9	45	D	-8
					PM	34	C	48	D	44	D	-4	45	D	-3
24	Kona St [c]	&	Ke'eaumoku St	AWSC / S [d]	AM	6	A	26	D	44	D	18	25	C	-1
					PM	8	A	15	C	28	C	13	43	D	28
25	Kona St	&	Pikoi St	S	AM	11	B	26	C	30	C	4	29	C	3
					PM	17	B	27	C	37	D	10	37	D	10
26	Kapiolani Blvd [a]	&	Keeaumoku St	S	AM	19	B	21	C	21	C	0	21	C	0
					PM	61	E	105	F	51	D	-54	45	D	-60
27	Piikoi St	&	Waimanu St	S [e]	AM	23	C	27	C	33	C	6	23	C	-4
					PM	24	C	35	D	47	D	12	33	D	-2
28	Piikoi St	&	Kapiolani Blvd [a]	S	AM	15	B	17	B	25	C	8	18	B	1
					PM	19	B	27	C	33	C	6	30	C	3
29	Ala Moana Blvd	&	Queen St	S	AM	13	B	15	B	15	B	0	14	B	-1
					PM	14	B	15	B	15	B	0	16	B	1
30	Kapiolani Blvd [a]	&	Kona Iki St	S	AM	4	A	5	A	6	A	1	6	A	1
					PM	11	B	14	B	14	B	0	14	B	0
31	Kona St	&	Kaheka St	AWSC / S [e]	AM	11	B	12	B	14	B	1	30	C	18
					PM	23	C	115	F	42	D	-73	45	D	-70
32	Kapiolani Blvd [a]	&	Kaheka St	S	AM	12	B	14	B	14	B	0	15	B	1
					PM	23	C	39	D	41	D	2	41	D	2

Measure of Effectiveness	Year 2008	2030 Base (ORTP)	2030 With Recommended Improvements [d]	2030 With Alternative Improvements [e]
Number of LOS D or better:	*61*	*57*	*63*	*63*
Number of LOS E:	*3*	*1*	*1*	*1*
Number of LOS F:	*0*	*6*	*0*	*0*

S: Singnalized. AWSC: All-Way Stop-Controlled. R: Roundabout
[a] Contra flow operation was resumed in the study area in December 2008 and, therefore, was assumed for both existing and all future scenarios.
[b] Existing Kona Street at Ke'eaumoku Street is controlled by stop signs in all appraoches. Proposed improvements included reconfiguration of this intersection to be a roundabout design and yield control for all approaches.
[c] Intersection geometry was reconfigured after the completion of the construction of the parking facility for the Ala Moana Center.
[d] Proposed improvement includes signalization.
[e] Piikoi/Waimanu - Waimanu is programmed to be two-way in 2030 scenarios. Two thru lanes were assumed to enter the Ala Moana Shopping Center.
[f] Traffic entering the H-1 westbound on-ramp at Pensacola Street would be allowed to access H-1 Freeway; however would not have access to Vineyard Boulevard.
[g] Traffic entering the H-1 westbound on-ramp at Pensacola Street would be able to use the H-1 mainline facilty; however would not be allowed to exit Vineyard Boulevard.



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December 16, 2009

2030 WITH RECOMMENDED PLAN INTERSECTION OPERATING CONDITIONS ADJACENT TO FUTURE GUIDEWAY STATIONS

FIGURE 15A

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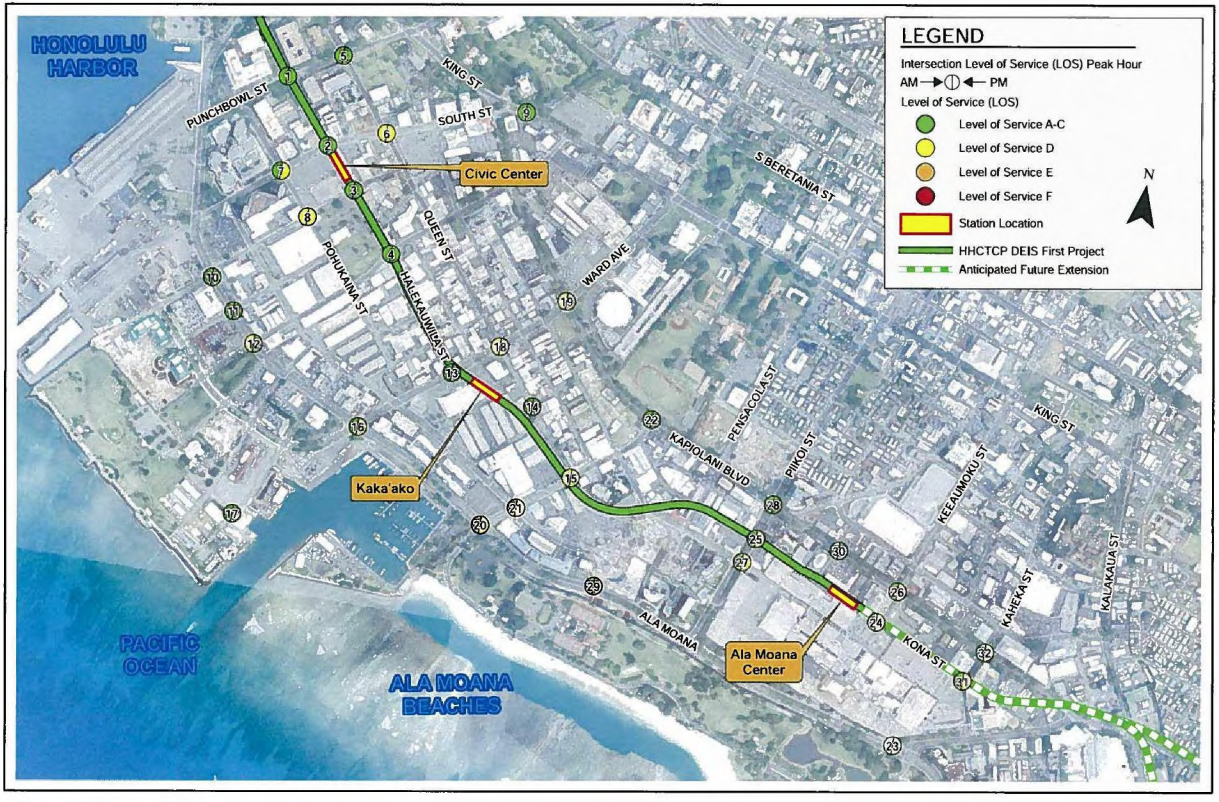

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2030 WITH ALTERNATIVE PLAN INTERSECTION OPERATING CONDITIONS ADJACENT TO FUTURE GUIDEWAY STATIONS

FIGURE 15B

TABLE 11

RECOMMENDED REGIONAL AND LOCAL ROADWAY IMPROVEMENT PLAN FOR THE KAKA'AKO AREAWIDE TRAFFIC STUDY

Types	Project #	Facility	Project Description	Cost Estimates (Millions of Year 2008 Dollar) [a]
Regional Roadway Improvements to Enhance H-1 Freeway Access	R 1	H-1 Westbound Left Hand Side Off-Ramp at Vineyard Boulevard	(1) Alter structure to provide a two-lane left-side off-ramp onto Vineyard Boulevard. The existing 3-lane approach segment would gain an "exit only" lane on the left and the left lane would have an option to exit onto Vineyard Boulevard. Vehicles entering H-1 from the 2-lane on-ramp at Lunalilo Street would merge into one-lane when the lane is added on the left and would merge with H-1 after the off-ramp and therefore not be able to access the Vineyard Boulevard off-ramp. (2) Additional right-of-way may be required to accommodate the column placement on the mauka side of the H-1 Freeway at Lunalilo Street and Ward Avenue.	$119.0
	R2	H-1 Westbound Lunalilo Street On-Ramp	If Project R1 is implemented, provide two lanes on the Lunalilo Street on-ramp which would merge into a single lane before merging with H-1 after the Vineyard Boulevard off-ramp. Vehicles would be allowed to access H-1 but not Vineyard Boulevard.	$9.0
	R3	Lunalilo Street and Pensacola Street intersection	Provide one left-turn lane, a shared through/left-turn lane, a through lane, and a free right-turn lane on the westbound approach (split phasing) and a through lane, a shared through/right-turn lane, and a right-turn lane with no right-turn on red on the southbound approach (split phasing) to the Lunalilo Street and Pensacola Street intersection.	$0.7
	R4	Pensacola Street from Pi'ikoi Street (north of Wilder Avenue) to Lunalilo Street	(1) Provide one-lane in the northbound direction and two lanes in the southbound direction on Pensacola Street from Pi'ikoi Street to Lunalilo Street. (2) Provide signage and signals to indicate two-way operation. Reorient the southbound facing parking along the east curb of Pensacola Street to a northbound direction.	$0.2
	R5	Pensacola Street and Wilder Avenue/Pi'ikoi Street intersections	(1) Provide the following lane configurations at the Wilder Avenue and Pensacola Street intersection: Northbound - all shared (permitted phasing), Southbound - shared through/left-turn lane and shared through/right-turn lane (permitted phasing), Eastbound - shared through/left-turn lane and a right-turn lane (split phasing), Westbound - one left-turn lane, a shared through/left-turn lane, and a right-turn lane (split phasing), (2) Provide an uncontrolled through lane in the northbound and southbound directions and stop-controlled left- and right-turn lanes on the westbound approach to the Pi'ikoi Street and Pensacola Street intersection. (3) Restrict parking in the non-functional westbound right-turn lane to provide a westbound right-turn lane.	$0.5
	R6	H-1 Westbound off-ramp at Lunalilo Street	Shift off-ramp westward closer to Liholiho Street to lengthen weaving section with Punahou Street.	$4.9
	R7	H-1 Eastbound On-Ramp at Pali Highway	(1) Widen on-ramp to provide two lanes onto H-1. The existing 3-lane auxiliary segment would need to be restriped to provide one trap lane onto the H-1 on-ramp, one trap lane onto the Punchbowl Street off-ramp, and one lane with access to both. (2) A physical barrier would be provided to restrict H-1 off-ramp traffic to the Punchbowl Street off-ramp.	$4.5
	R8	H-1 Eastbound mainline from Pali Highway On-Ramp to Kinau Street Off-Ramp (weave section)	Widen section of H-1 to 5 lanes to provide additional capacity and to accommodate the new two-lane on-ramp from Pali Highway.	$12.5
	R9	H-1 Eastbound Off-Ramp at Kinau Street	Widen off-ramp to provide two lanes from H-1. This improvement is also needed to accommodate the additional H-1 lane from Project R8.	$10.1
	R10	H-1 Eastbound off-ramp/Kinau Street and Kinau Street/Ward Avenue Intersections	(1) Install a physical barrier to eliminate the stop-controlled eastbound through movement while providing side-street stop-control on the existing uncontrolled eastbound through lane. (2) Restripe the eastbound approach to the Kinau Street/Ward Avenue intersection to provide a shared through/left-turn lane, two through lanes, and a right-turn lane.	$0.1
	R11	Kinau Street between Ward Avenue and Pi'ikoi Street	Implement peak hour parking restrictions and "Anti-Gridlock Zone" signs on one side of Kinau Street between Ward Avenue and Pi'ikoi Street to provide 3 lanes in the eastbound direction.	$0.1
	R12	Pi'ikoi Street and Kinau Street/Lunalilo Street Intersections	(1) Provide two left-turn lanes, two through lanes, and a free right-turn lane to the H-1 eastbound on-ramp on the northbound approach to the Pi'ikoi Street and Lunalilo Street intersection (split phasing). Provide proper signage to direct motorists wishing to make a left-turn onto Pensacola Street to use the left-most left-turn lane, motorists wishing to make a right-turn onto Pensacola Street to use the right-most left-turn lane, and vehicles wishing to access H-1 to use either left-turn lane. Also provide two through lanes and a free right-turn lane onto Piikoi Street on the westbound approach (split phasing). (2) Remove approximately 3 parking spaces (for a total ~ 150' of red curb) from the south curb of the east leg of the intersection of Piikoi St & Kinau Ave in order to allow a safe merging of the eastbound through vehicles due to curb side parking. (The peak hour parking restriction does not apply east of Piikoi St.)	$0.7

TABLE 11

RECOMMENDED REGIONAL AND LOCAL ROADWAY IMPROVEMENT PLAN FOR THE KAKA'AKO AREAWIDE TRAFFIC STUDY

Types	Project #	Facility	Project Description	Cost Estimates (Millions of Year 2008 Dollar) [a]
Local Circulation Improvements in the Vicinity of Future Guideway Stations	L1	Circulatory roadways in Ward neighborhood [b]	(1) Improve the landscape and install sidewalks on Queen Street, Kawaiahao Street and Waimanu Street between Ward Avenue and Kamakee Street	$1.6
			(2) Improve the landscape and install sidewalks on Hopaka Street and Kona Street from Kamakee Street to Piikoi Street	$3.0
			(3) Extend Halekauwila Street from Ward Avenue to Kamakee Street to provide direct access from Ward neighborhood to the Civic Center area	$17.8
			(4) Extension of Cummins Street from Queen Street to Ala Moana Boulevard	$15.9
			(5) Extension of Pohukaina Street from Kamani Street to Ward Avenue	$5.1
			(6) Extension of Ahui Street from Pohukaina Street to Ala Moana Boulevard	$11.4
			(7) Extension of Queen Lane from Ala Moana Boulevard to Waimanu Street	$16.5
			subtotal (1) thru (7)	$71.2
	L2	Ward Avenue/Ala Moana intersection	Restripe the southbound approach of Ward Avenue from one shared thru/right lane, one shared thru-left lane and one exclusive left turn lane to one exclusive right turn lane, one shared thru/left lane and one exclusive left turn lane. Modify the signal timing and phasing to increase green time for the northbound approach.	$0.02
	L3	Ward Avenue/Queen Street intersection	(1) Restripe both approaches of Queen Street from a single lane to a right turn lane and a shared thru-left turn lane.	$0.04
			(2) Remove parking on the mauka side of Queen Street east of Ward Avenue (approximately five 90-degree parking spaces) and on the makai side of Queen Street west of Ward Avenue (approximately 2 curb parking spaces).	
	L4	Kamakee Street/Ala Moana Boulevard intersection	Modify existing signal timing plan to allocate more green time from Ala Moana Boulevard to Kamakee Street.	$0.004
	L5	Cooke Street/Halekauwila Street intersection	Reconfigure the stop controlled intersection to a single lane roundabout with landscaped central island and splitter island. Right-of-way acquisition would be required	$2.0
	L6	Kona Street/Ke'eaumoku Street intersection	Proposed Improvement: Install new signals for traffic and pedestrians. [c]	$0.7
	L7	Kona Street/Kaheka Street intersection	Install new signals for traffic and pedestrians.	$0.7
	L8	Kapi'olani Boulevard/Ward Avenue intersection	(1) Widen the makai bound approach of Ward Avenue to add a right turn lane to facilitate the right turn vehicles from Ward Avenue to Kapi'olani Ewa bound.	$2.2
			(2) Remove the coned contra flow operation at this intersection during the P.M. peak hour (i.e., current P.M. contra flow operation on Kapi'olani Boulevard ends between Cooke Street and South Street. With this improvement, contra flow would end between Kamakee Street and Ward Avenue); Left turn from Kapi'olani Boulevard to Ward Avenue would remain restricted.	
				$239.12

Note:

[a] These estimates do not include costs associated with right-of-way acquisition.

[b] The concept improvements were developed based on review of two documents: (1) *Draft Mauka Area Plan - Kaka'ako Hawaii Community Development District, Honolulu, Hawaii, Hawaii Community Development Authority (HCDA), May 2007, and (2) Ward Neighborhood Master Plan, General Growth Properties, Inc., (GGP), April 16, 2008*

[c] Signalization of Kona Street and Ke'eaumoku Street intersection would be consistent with the traffic mitigation measure proposed at this location in the *Honolulu Capacity Transit Corridor Project - Draft Environmental Impact Statement/Section 4(f) Evaluation, November 2008, City and County of Honolulu*.

Source: Fehr & Peers, 2009.

7. CONCLUSIONS

The study analyzed existing and future transportation conditions of the Kaka'ako-Makiki area and identified transportation deficiencies and causes of regional and local traffic congestion in the vicinity of future guideway transit stations (Kaka'ako Station, Civic Center Station, and Ala Moana Station). Integrated traffic forecasting and simulation models were used for the development and evaluation of various alternative strategies and concepts for the study area. After considering the benefit and cost of the project improvement alternatives, this report provides specific improvements that could offer mobility benefits to the region and the station area.

The plan recommends 20 roadway improvements projects in the contexts of both regional access (12 projects) and local circulation near future guideway stations (8 projects). Highlights of the plan and the corresponding project numbers are:

- Add a new left-hand off-ramp from H-1 to Vineyard Boulevard, with reconfiguration of existing Vineyard Boulevard flyover (R1)
- Re-open access from the Lunalilo on-ramp to the H-1 Freeway during the AM peak period, and provision of two lanes on the Lunalilo Street on-ramp which would merge into a single lane before merging with H-1 after the Vineyard Boulevard off-ramp (R2)
- Widen the H-1 eastbound mainline from the Pali Highway on-ramp to the Kinau Street off-ramp by one lane to allow two lanes to enter from Pali Highway to H-1 (R7 & R8)
- Widen H-1 eastbound off-ramp at Kinau Street from one to two lanes (R9)
- Shift H-1 westbound off-ramp at Lunalilo Street to lengthen the weaving section with Punahou Street (R6)
- Peak hour parking restriction on one side of Kinau Street between Ward Avenue and Pi'ikoi Street for an additional eastbound travel lane (R10 & R11)
- Convert Pensacola Street mauka of Lunalilo Street to just north of Wilder Avenue to two-way operations (with one lane northbound and two lanes southbound) (R4)
- Improve access to H-1 Freeway ramps by modifying lane geometry at three intersections: Lunalilo Street/Pensacola Street, Pi'ikoi Street/Kinau Street/Lunalilo Street, and Pensacola Street/Wilder Avenue/Pi'ikoi Street (R3, R5 & R12)
- New circulation roadways near the future Kaka'ako guideway transit station and the Ward neighborhood (L1)
- Improve access to future guideway station area by modifying lane geometry and/or control devices at these intersections: Ward Avenue/Ala Moana, Ward Avenue/Queen Street, Kamakee Street/Ala Moana Boulevard, Cooke Street/Halekauwila Street, Kona Street/Ke'eaumoku Street, Kona Street/ Kaheka Street, and Kapi'olani Boulevard/Ward Avenue (L2-L8)

An alternative improvement plan was developed and fully analyzed to study the effect of adding a right-hand off-ramp from Ewa-bound H-1 to Vineyard Boulevard (as opposed to the recommended left-hand off-ramp structure). The alternative plan is expected to reduce travel time and system congestion level over future base conditions; however, it would not carry as much traffic to the H-1 Freeway as the recommended plan. Therefore, the Recommended Plan featuring a new left-hand off-ramp from Ewa-bound H-1 to Vineyard Boulevard is the preferred plan of this study.

APPENDIX A:
TECHNICAL MEMORANDUM: KAKA'AKO AREAWIDE TRAFFIC STUDY – TRAFFIC OPERATIONS MODEL DEVELOPMENT (FEHR & PEERS, DECEMBER 2009)

APPENDIX A: KAKA'AKO AREAWIDE TRAFFIC STUDY – TRAFFIC OPERATIONS MODEL DEVELOPMENT

As a supplement to *Honolulu High Capacity Transit Corridor Project (HHCTCP) Draft Environmental Impact Study* (DEIS), Fehr & Peers prepared *Kaka'ako Areawide Traffic Study* (Fehr & Peers, March 2009) for the City and County of Honolulu to assess regional and local access to future guideway transit stations and the surrounding high-density commercial and residential development in the Kaka'ako-Makiki areas of O'ahu, Hawaii. The Kaka'ako study identifies the regional freeway bottlenecks and causes of local traffic congestion in the study area and presents an areawide transportation improvement program that aids mobility. A key element of the analysis is the operations of the H-1 Freeway, which runs east-west approximately three miles north of the stations.

This technical memorandum summarizes the data collection effort and methodology used to develop the traffic demand forecasting and operations model for *Kaka'ako Areawide Traffic Study*. Development of the intersection operating conditions analysis and discussions related to the effect of reversal of Pensacola Street-Pi'ikoi Street one-way couplet are also included.

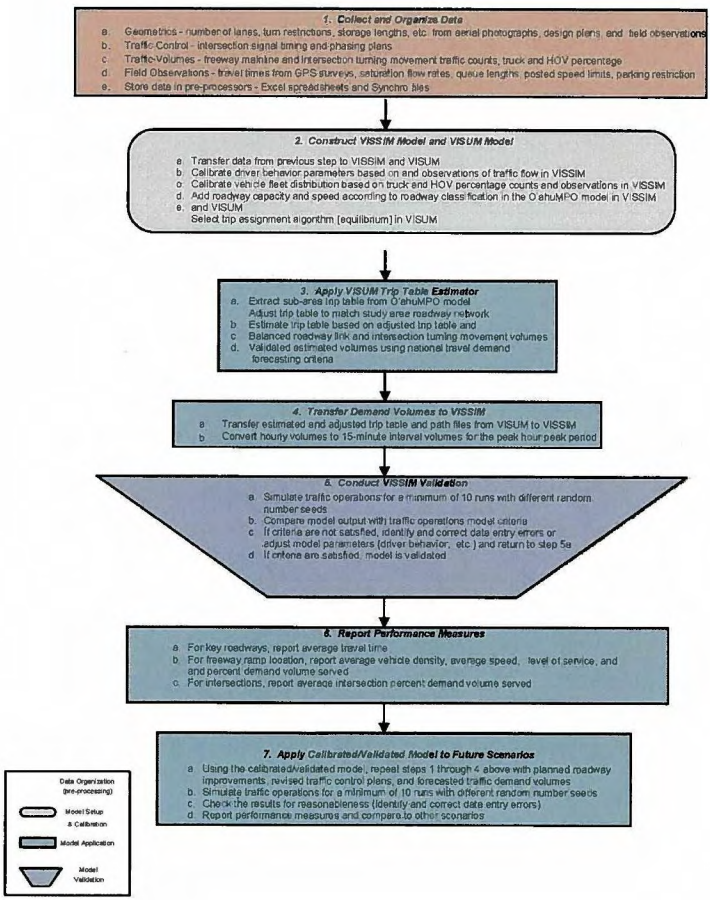
FORECASTING AND OPERATIONS TOOLS

The H-1 Freeway and the local arterials in the study area operate as a system with congestion and delays affecting both upstream and downstream operations. The study approach includes a traffic forecasting process that uses the island-wide regional travel demand forecasting model and VISUM modeling software package for the study area. The island-wide model is a newly expanded four-step model calibrated for the island of O'ahu for the O'ahu Metropolitan Planning Organization (O'ahuMPO). The O'ahuMPO model was developed for *O'ahu Regional Transportation Plan 2030* (ORTP) (O'ahuMPO 2007) and used for the HHCTCP DEIS. A sub-area from the regional travel model was extracted using VISUM and was used to develop and facilitate a more detailed estimation of travel patterns on a turning movement level of detail. VISUM allows the process to capture the local-scale distributional effects of roadway improvements made to the H-1 freeway and arterials in the study area. Of particular interest were the major improvements to the interchanges and the shift in traffic patterns associated with the improvements.

The project area experiences severe congestion at the freeway interchanges, with gridlock conditions on most ramp access intersections resulting in increased neighborhood cut-through traffic. Travel patterns in the study area are sensitive to changes in roadway capacity, signal operations, and traffic demand. The demand-based VISUM model is supplemented with the traffic operations tool, VISSIM. The VISSIM traffic micro-simulation model was used to conduct network-wide evaluations of traffic operations including corridor travel time estimates, focused analyses of freeway ramp access, and intersection queuing/delay. Field observations and on-road surveys were conducted for the major corridors during the peak periods to calibrate the VISSIM micro-simulation model. The results from the VISUM and VISSIM model runs were used to identify existing and future roadway deficiencies and improvement opportunities

To understand how these models were in the integrated systems approach, an overall work process flow chart was prepared as shown in Figure A-1. A more detailed description of the process is presented below.

FIGURE A-1
MODEL DEVELOPMENT PROCESS FOR THE KAKA'AKO STUDY



TRAFFIC FORECASTING MODEL DEVELOPMENT

The island-wide O'ahuMPO model focuses on estimating regional travel for the entire island of O'ahu. Since the proposed project improvements will focus on a localized area of the island, the regional model would need to be supplemented by a more detailed sub-area model.

To improve on the level of detail in the forecasting process, the VISUM modeling software was used to extract a sub-area of the regional model and enhance its level of detail. VISUM has the same standard features as traditional travel demand models as well as other features that allow the model to capture the local-scale distributional effects of roadway improvements more accurately. VISUM is capable of refining regional travel patterns to match observed traffic volumes and can utilize a wide range of sophisticated assignment algorithms to assign trips to the network based on roadway link capacity as well as turning movement capacities. Therefore, the regional model was used as a macro-level planning tool for trip generation, trip distribution, and mode split, while the VISUM model was used for detailed trip assignment in the sub-area.

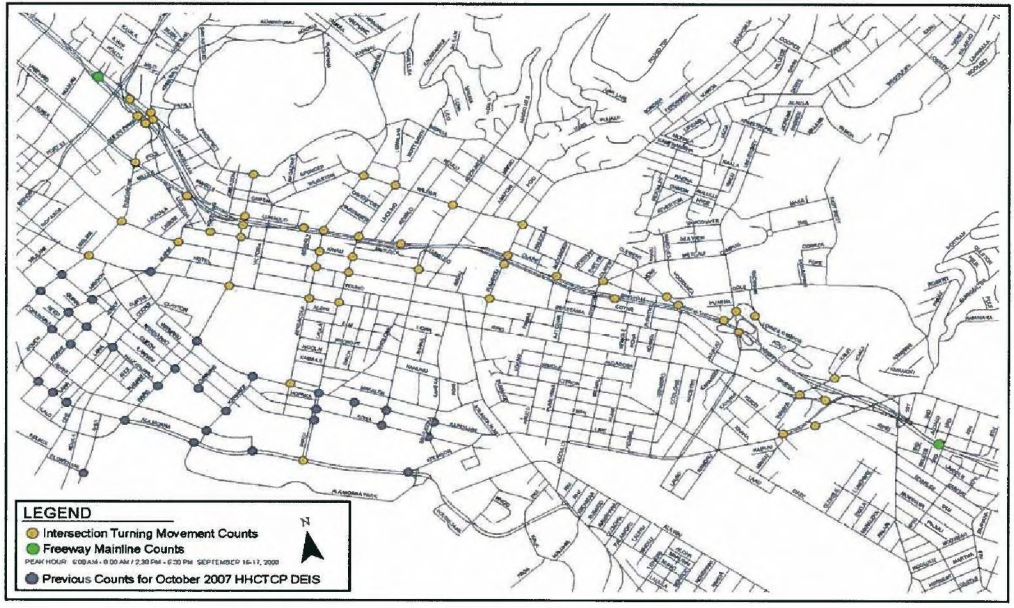
Base Year (2008) VISUM Model Development

The first step in the forecasting process was to develop a base year AM and PM peak period VISUM model for the Kaka'ako-Makiki area. Considering the traffic patterns and congestion in the study area, the morning and afternoon peak periods covered from 6:00 to 8:00 AM and from 2:30 to 6:30 PM. The process involved: (1) data collection, (2) sub-area model validation and sub-area extraction, (3) VISUM model development, and (4) VISUM model calibration and validation.

Data Collection

New traffic counts and lane geometries were collected at 58 intersections and 35 H-1 Freeway facilities (segments and ramps) in September 2008 for this analysis. October 2007 count data collected at 23 intersections for the traffic analysis of the proposed guideway transit station area in the DEIS were also used. Figure A-2 illustrates the traffic count locations. Two freeway mainline counts were collected on the H-1 Freeway immediately west of the Pali Highway Interchange and immediately east of the Kapahulu Avenue Interchange to capture the traffic entering and exiting the study area.

With the volumes on both ends of the study area and the segment count data for traffic entering and exiting all the ramps, traffic volumes were estimated for each freeway mainline section between ramps. The AM and PM peak period intersection turning movement traffic counts were balanced between closely-spaced intersections and used to calibrate and validate the sub-area VISUM model. Lane geometries collected from the field were used to develop individual turning movement capacities at all 73 study intersections for use in the trip assignment process. Posted speed limits, travel speeds and travel time on H-1 and major arterials during the peak hours were also collected.



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NEW PEAK HOUR TRAFFIC COUNT LOCATIONS
FIGURE A-2

Sub-Area Model Validation and Sub-Area Extraction

The most critical static measurement of the accuracy of any travel model is the degree to which it can approximate actual traffic counts in the base year. For a model to be considered accurate and appropriate for use in traffic forecasting, it must replicate actual conditions to within a certain level of accuracy.

A preliminary sub-area model validation was performed on the base year (2007) O'ahuMPO model to ensure macro-level traffic patterns were reasonable prior to their refinement in VISUM. Traffic forecasting models are typically calibrated by adjusting model parameters until they are validated by applying a set of criteria that compare model link volumes to actual counts. For the Kaka'ako Areawide Traffic Study, land use and roadway network modifications were made to the island-wide regional model to provide a more detailed analysis of the existing conditions in the study area. The resulting roadway link volumes were compared to roughly 400 intersection approach and departure volumes derived from turning movement counts collected in 2008.

Key validation standards for daily travel models were developed based on *Model Validation and Reasonableness Checking Manual* (Travel Model Improvement Program, Federal Highway Administration [FHWA], 1997).

- The [illegible]sum of [illegible]es on all [illegible]adway [illegible] [illegible]e available shou[illegible] be withi[illegible]0 p[illegible]cent of t[illegible] counts
- All o[illegible]he roadw[illegible]y s[illegible] should[illegible]e wi[illegible]in the [illegible]m desira[illegible]e deviation of at least[illegible]5 percent
- At le[illegible] percent o[illegible]he roadw[illegible]ks for wh[illegible] c[illegible]unts are availab[illegible] should be within the maximum desirable deviation, which ranges from approximately 15 to 60 percent depending on total volume (the larger the volume, the less deviation is permitted).
- The percent root mean square (RMSE) should not exceed 40 percent.
- The correlation coefficient between the actual ground counts and the estimated traffic volumes should be greater than 88 percent.

Regional model link validation results are presented below.

TABLE A-1
O'AHUMPO MODEL PEAK PERIOD VALIDATION

Validation Statistic	Threshold	AM Peak Period (2 Hour)	PM Peak Period (4 Hour)
Model/Count Ratio	Between 0.90 and 1.10 (i.e., Within ±10%)	1.00	1.00
% of Screenlines Within Maximum Deviation	> 75%	100%	100%
% of Links Within Maximum Deviation	> 75%	76%	78%
RMSE	< 40%	29%	33%
Correlation Coefficient	> 0.88	0.96	0.95

Source: Fehr & Peers, 2009

As shown in Table A-1, both the AM and PM peak period models passed all the validation criteria at the link level. Therefore, the base year (2007) O'ahuMPO model is considered to be valid to 2008 traffic counts. Additionally, a model-to-count ratio of 1.00 indicates the magnitude of trips in the study area is appropriate, while validating along all screenlines indicates the directionality of trips in the study area is appropriate.

A sub-area extraction of AM and PM peak period origin-destination trip tables was then performed on the validated base year O'ahuMPO model. This process involved drawing a cordon around the study area to capture the destination of trips leaving the model and the origin of trips entering the model.

These trips are then aggregated into singular zones, representing points at which vehicles can enter and exit the study area. The resulting trip tables are the source of macro-level traffic patterns in the study area that are refined in VISUM.

Existing VISUM Model Development

Using aerial photography and field data, a VISUM model was developed for the project study area for base year (2008) conditions. The VISUM model was coded with the same attributes typically entered in a regional demand model such as roadway speeds and capacities, which were based on values coded in the validated O'ahuMPO model. Detailed intersection characteristics such as intersection control and turn movement capacities not typically specified in a regional demand model were also coded in the VISUM model. The additional detail results in a greater understanding of traffic diversion as a result of roadway improvements and greater confidence in the resulting forecasts.

Like standard travel demand models, a traffic analysis zone (TAZ) structure was developed for the VISUM model that corresponds to the TAZ system from the O'ahuMPO sub-area model. TAZs that correspond to locations where trips enter and exit the network were included along with intermediate "driveway" TAZs that account for traffic originating and terminating in the study area. This TAZ system maintains balanced traffic volumes, which are critical in the development of origin-destination trip tables for use in VISUM.

Unlike standard travel demand models, the VISUM model does not include zonal land use data as an input. Instead, the origin-destination trip tables from the validated O'ahuMPO base year travel demand forecasting (TDF) model were imported into VISUM. Additionally, the existing peak period traffic volumes (both intersection and freeway volumes) were imported into the VISUM model since VISUM has the ability to adjust origin-destination trip tables to match observed volumes by utilizing the relation of intersection turning movements and the macro-level traffic patterns from the O'ahuMPO model. The matrix adjustment module (TFlowFuzzy) in VISUM was executed to iteratively adjust the origin-destination trip tables from the O'ahuMPO model to match observed traffic counts.

The TFlowFuzzy process is based on matrix correction research by Zuylen/Willumsen, Bosserhoff, and Rosinowski. The process uses complex vector analysis with the matrix values used as weights for the origin-destination relations and the upper and lower bounds of the traffic counts used to provide some slack in finding a solution to the matrix collection problem. Since the matrix correction procedure finds a solution to match the traffic counts, it is not necessary that the traffic counts and the origin-destination trip table represent the same year. The end result is a refined origin-destination (AM and PM peak period) trip table based on the macro-level trip distribution and assignment results from the O'ahuMPO model, as well as actual field counts.

Existing VISUM Model Calibration and Validation

The trips in the refined origin-destination matrices are then assigned to the roadway network and the estimated turning movement volumes are compared to traffic counts using a set of criteria that compares model volumes to actual counts. If the turning movement volumes are not within acceptable validation, the model is calibrated by adjusting link capacities and speeds. The origin-destination matrix is validated when the differences between the estimated and observed turning movement volumes meet the criteria described below. The criteria were developed based on the Federal Highway Administration and were adopted by other state departments of transportation (California Department of Transportation [Caltrans]).

- For volumes less than 700 vehicles per hour (vph), within 100 vph
- For volumes between 700 and 2,700 vph, within 15 percent
- For volumes greater than 2,700 vph, within 400 vph

Table A-2 shows the validation results for the AM and PM peak period origin-destination matrices. Exhibits 1 and 2 show the validation results by iteration for the AM and PM peak periods, respectively.

As shown in Table A-2, roughly 98% of all turning movement volumes fell within the validation criteria for both the AM and PM peak periods. The turning movement volumes that did not fall within the validation criteria were generally low-volume turning movements. Exhibits 1 and 2 indicate that the origin-destination matrix process converged rapidly, generally matching the validation criteria by the third iteration. The rapid convergence is due to the use of origin-destination matrices from the well-calibrated O'ahuMPO model, which was validated to approach and departure volumes.

TABLE A-2
ORIGIN-DESTINATION MATRIX ESTIMATION VALIDATION RESULTS

Volume Range[1]	AM Peak Period		PM Peak Period	
	Number[3]	% Met[2]	Number[3]	% Met[2]
< 700 vph	309	98.7%	331	99.4%
700 to 2,700 vph	114	100.0%	121	99.2%
> 2,700 vph	1	100.0%	3	100.0%
Total	424	98.3%	455	98.7%

Notes:
[1] The peak period volumes were translated to match the peak hour volume range thresholds by multiplying model flows and counts by 0.536 and 0.262 in the AM and PM peak periods, respectively.
[2] The percent of link volumes that meet the validation criterion.
[3] The total number of turning movement volumes differ from AM to PM peak periods because turning movement volumes less than 50 vehicles in the two-hour AM peak period and four-hour PM peak period were not included.

Source: Fehr & Peers, 2009

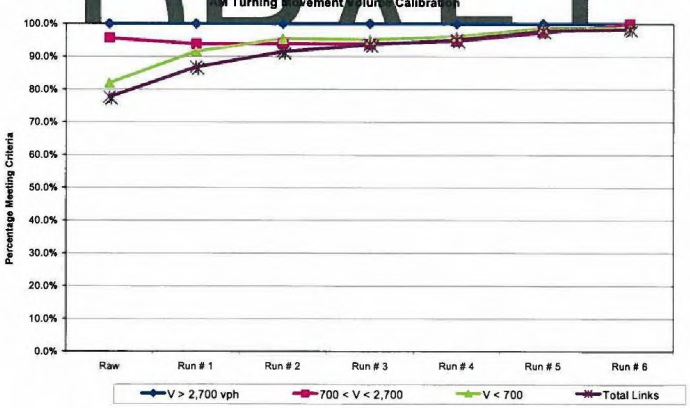
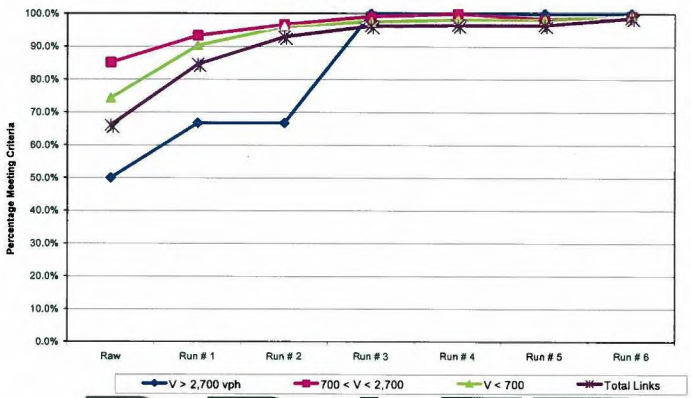


Exhibit 2
PM Turning Movement Volume Calibration



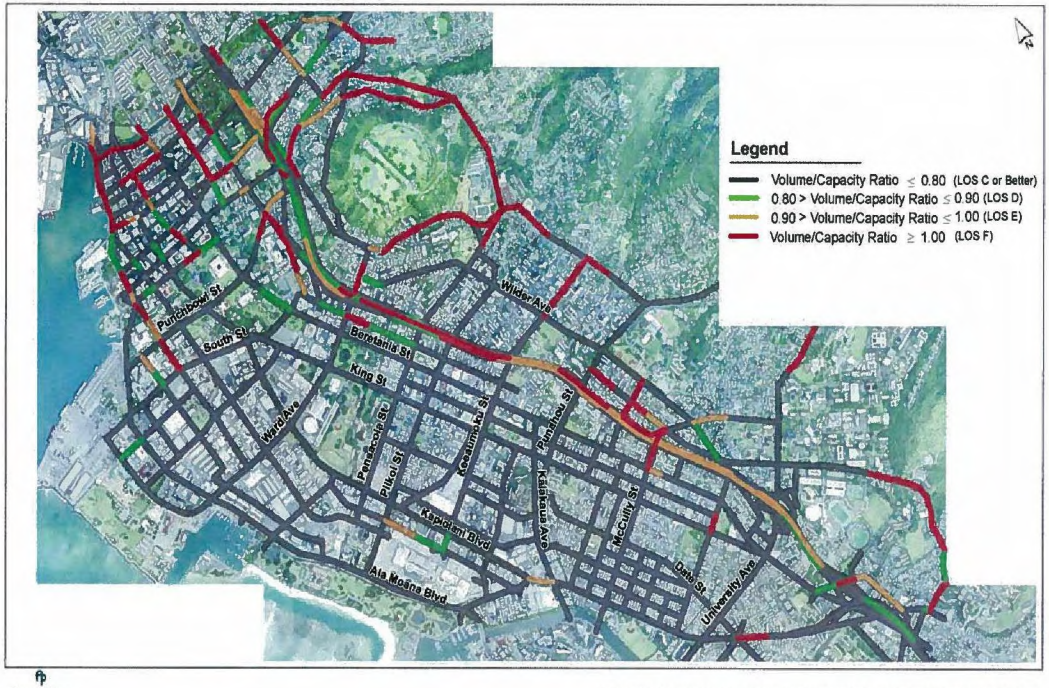
The more traditional validation approach from the preliminary sub-area model validation process was then applied to the final origin-destination matrices at the turning movement level to further test the validity of base year (2008) flows from the VISUM model. As shown in Table A-3, both the AM and PM peak period models passed all the validation criteria for approximately 540 turning movement volumes.

TABLE A-3
PEAK PERIOD VISUM MODEL TURNING MOVEMENT VALIDATION

Validation Statistic	Threshold	AM Peak Period (2 Hour)	PM Peak Period (4 Hour)
Model/Count Ratio	Within 10%	1.02	1.01
Percent Of Turns Within Caltrans Maximum Deviation	> 75%	85%	86%
Percent RMSE	< 40%	22%	17%
Correlation Coefficient	> 0.88	0.99	1.00

Source: Fehr & Peers, 2009

Figures A-3 and A-4 illustrate the validated VISUM model for existing 2008 conditions and roadway volume-to-capacity (V/C) utilization conditions during the AM peak hour and PM peak hour, respectively. Global peak hour factors of 0.26 and 0.54 were developed from AM two-hour peak period counts and PM four-hour peak period counts for this roadway peak hour V/C analysis.



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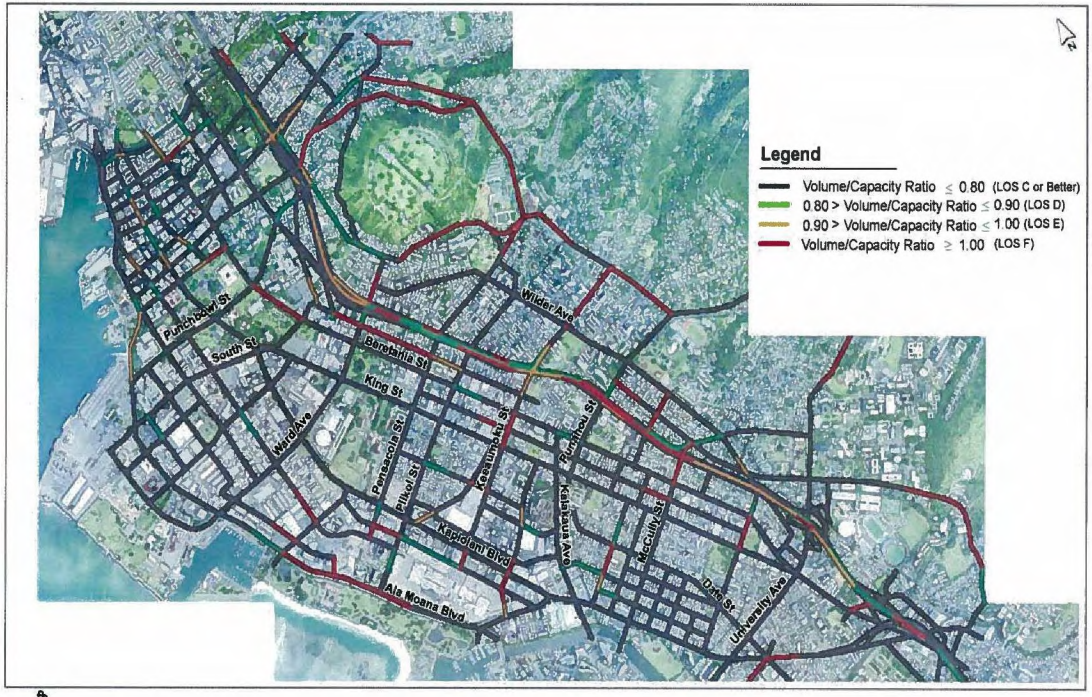
2008 EXISTING PEAK HOUR ROADWAY OPERATING CONDITIONS - AM PEAK HOUR
FIGURE A-3



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2008 EXISTING PEAK HOUR ROADWAY OPERATING CONDITIONS - PM PEAK HOUR
FIGURE A-4

Future Year (2030) VISUM Model Development

The next step in the forecasting process was to develop a future year (2030) AM (two-hour) and PM (four-hour) peak period VISUM model based on the base year (2008) calibrated/validated VISUM model.

2030 Travel Demand Forecasts

Future year (2030) trip tables were developed with the use of the future year (2030) O'ahuMPO travel demand forecasting model. This ensures the origin-destination trip tables assigned by VISUM reflect the anticipated growth in the project study area by year 2030 as estimated by the O'ahuMPO travel demand model. Since the 2030 O'ahuMPO model was derived from the base year O'ahuMPO model, the same roadway network modifications made to calibrate the base year O'ahuMPO model were incorporated into the 2030 model. Additionally, the 2030 model was checked to ensure the transit improvements proposed under the First Project Alternatives were included. The trip tables were then assigned to the modified roadway network, and a sub-area extraction of AM and PM peak period origin-destination trip tables was performed.

The future conditions origin-destination matrix is then developed by adding predicted growth between the base and future year travel demand forecasting models to the validated origin-destination matrix.

The resulting trip tables were compared to the trip tables from the base year O'ahuMPO model to ensure a reasonable growth (or decline) in traffic between individual origin-destination pairs. If an unrealistic growth or decline was observed between an origin and destination, the flow between the origin-destination pair was adjusted. The future year (2030) origin-destination matrix was then developed by adding the difference between the base and future year trip tables from the O'ahuMPO model to the refined VISUM base year (2008) origin-destination trip table developed during the VISUM calibration/validation process.

The approach described above is very similar to other model adjustment techniques like the "difference method," which applies the following formula:

Adjusted Future Volume = Field Count + (Model Future Volume – Model Base Volume)

However, instead of applying the technique at the link level, the technique is applied at the origin-destination level to better reflect the model's growth predictions.

2030 VISUM Model Development

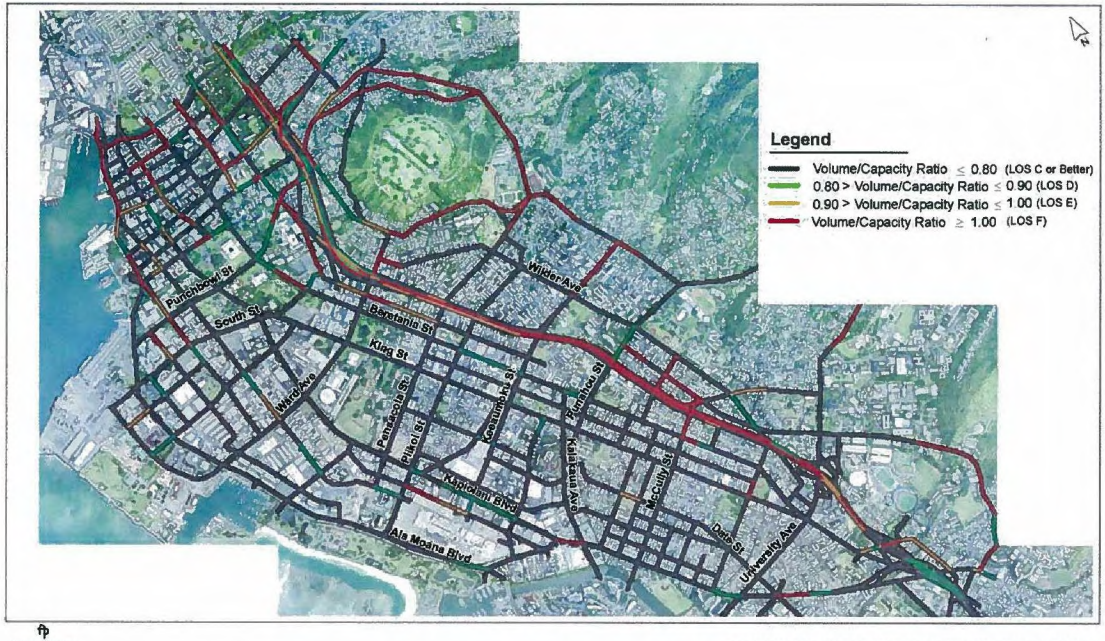
The validated base year (2008) VISUM model was modified to include future baseline roadway improvements assumed in the 2030 O'ahuMPO model. The following programmed roadway improvements in the project study area were included as part of the 2030 Baseline (No Build) conditions:

- Widening of H-1 eastbound between Ward Avenue and Punahou Street from three to four lanes
- Conversion of Waimanu Street between Pensacola Street and Pi'ikoi Street from four lanes in the eastbound direction to a two-way street with two lanes in each direction

The resulting 2030 baseline roadway network was then modified to include regional roadway improvements and local station area circulation improvements proposed in the Recommended Roadway Improvements Plan and the Alternative Roadway Improvements, as described in Chapter 6 of *Kaka'ako Areawide Traffic Study*.

The final future year (2030) origin-destination matrix was then assigned to 2030 roadway network alternatives, including future baseline (with *2030 ORTP*), 2030 with Recommended Plan, and 2030 with Alternative Plan. Conventional parameters such as link capacities and speeds as well as innovated parameters such as intersection control and turning movement capacities were both taken into account during the traffic assignment procedure. It is important to note the same origin-destination matrices were assigned to all three roadway network alternatives. This way the same amount of travel demand would be preserved between origins and destinations and is not expected to change across different 2030 scenarios. Instead, only actual routes vehicles travel from their origin to their destination are expected to change. Analysis of identical travel demand patterns over varying roadway networks would obtain a true apples-to-apples comparison of all three future alternatives.

Figures A-5 and A-6 illustrate the validated VISUM model for future 2030 baseline roadway utilization conditions during the AM peak hour and PM peak hour, respectively. Figures A-7 and A-8 illustrate the peak hour roadway V/C analysis for future 2030 with Recommended Plan conditions during the AM peak hour and PM peak hour, respectively. Figure A-9 and A-10 depicts the V/C analysis for future 2030 with Alternative conditions during the AM peak hour and PM peak hour, respectively.



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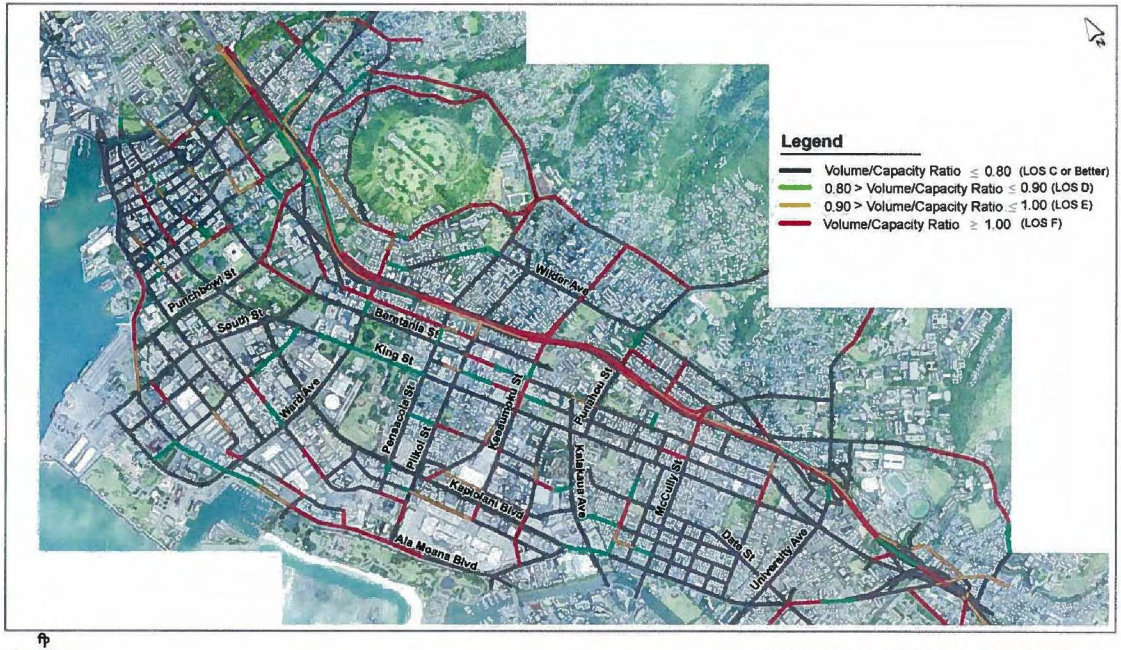
2030 BASE ROADWAY OPERATING CONDITIONS - AM PEAK HOUR
FIGURE A-5



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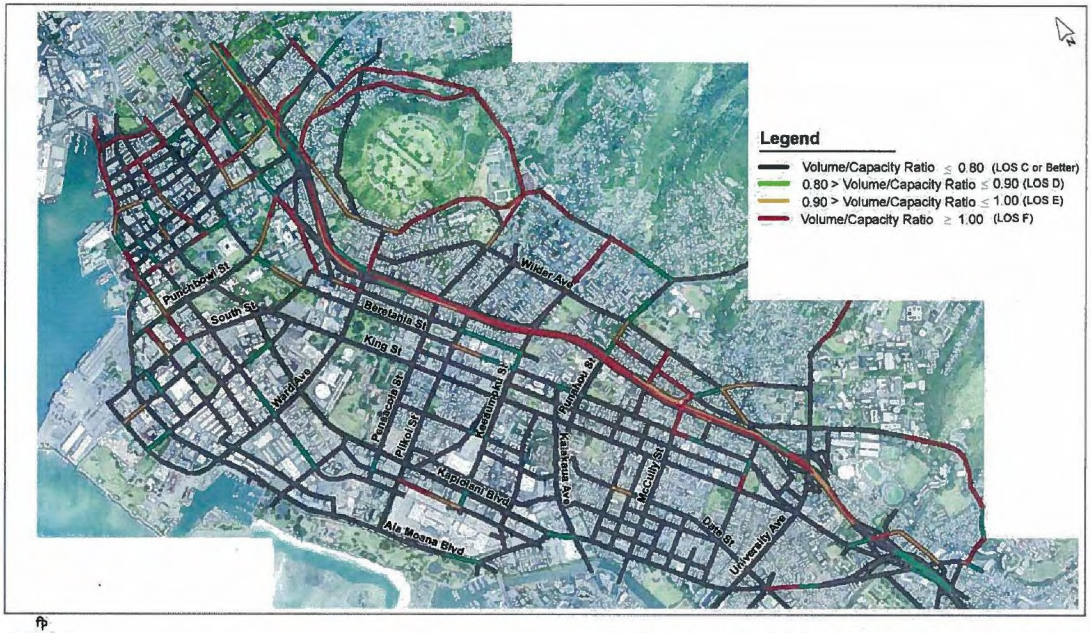
2030 BASE ROADWAY OPERATING CONDITIONS - PM PEAK HOUR
FIGURE A-6



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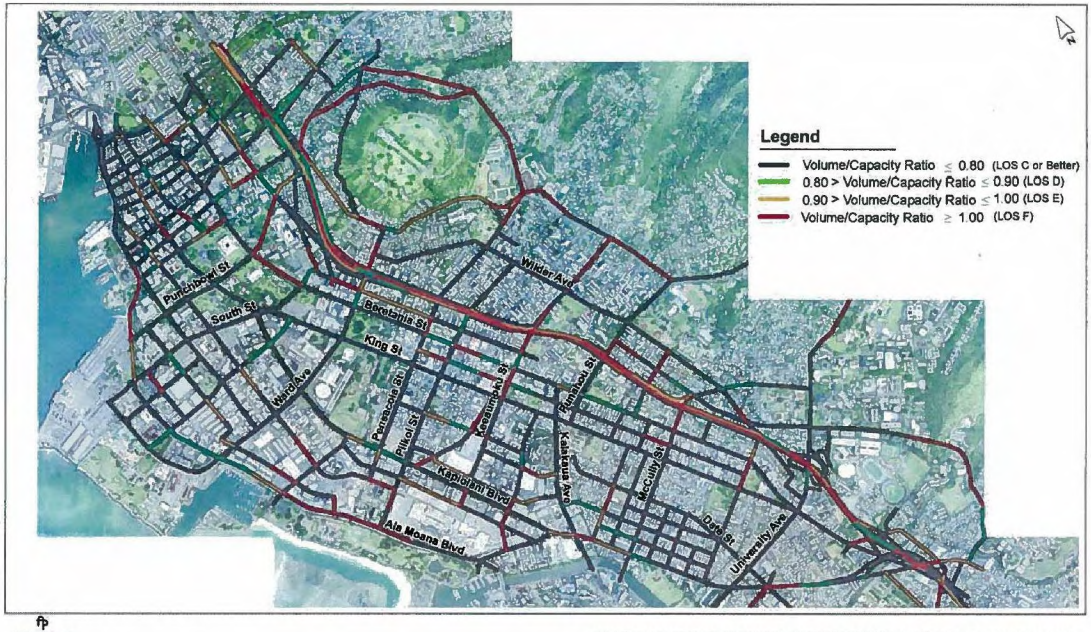
2030 WITH RECOMMENDED PLAN ROADWAY OPERATING CONDITIONS - AM PEAK HOUR
FIGURE A-7



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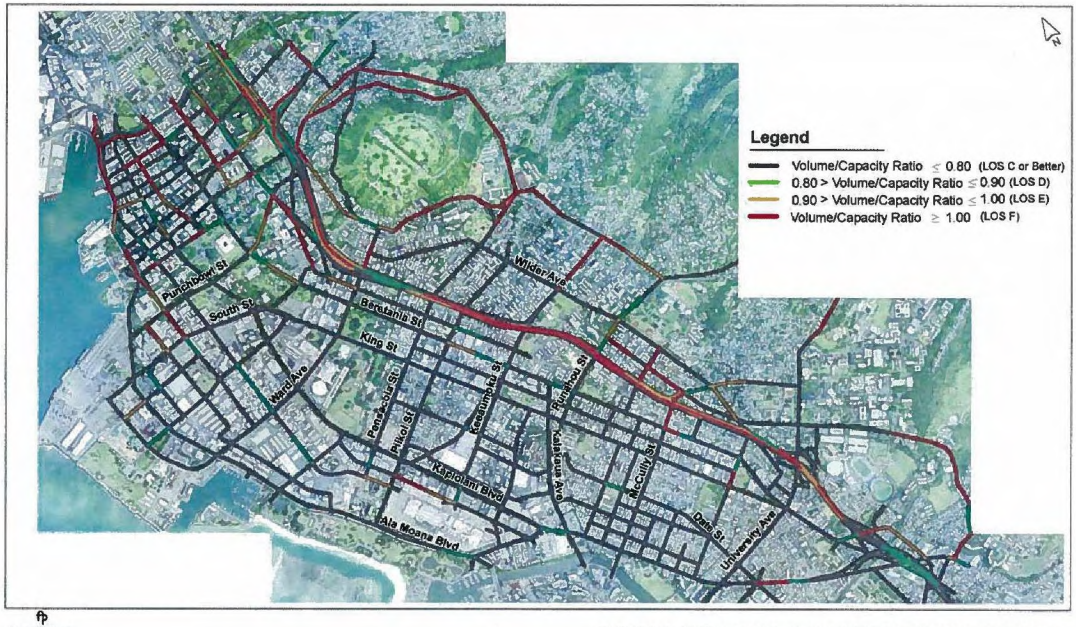
2030 WITH RECOMMENDED PLAN ROADWAY OPERATING CONDITIONS - PM PEAK HOUR
FIGURE A-8



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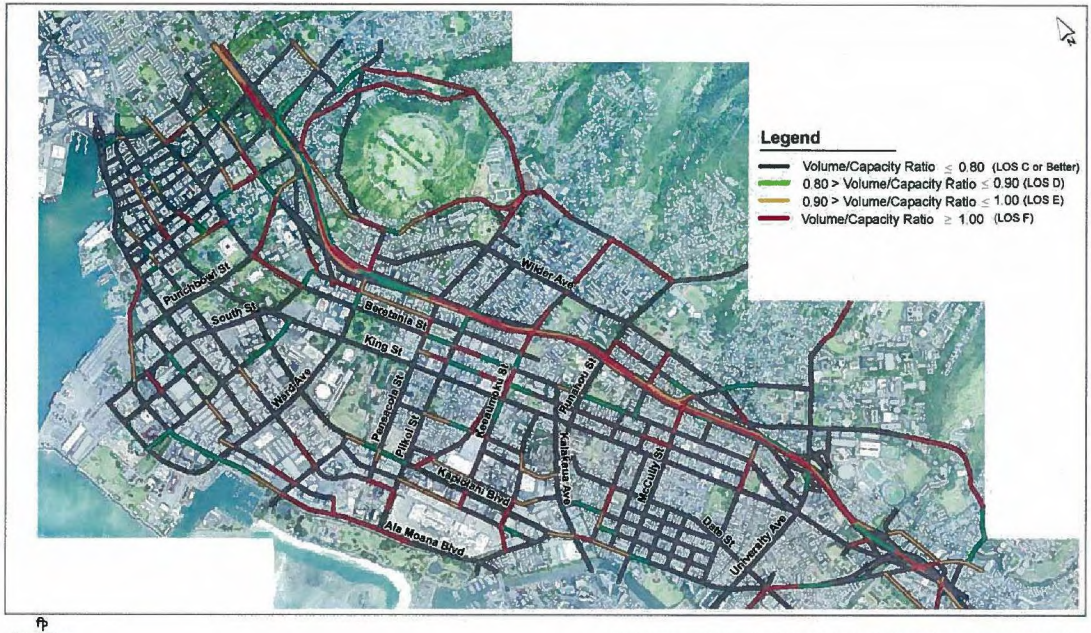
2030 WITH ALTERNATIVE PLAN ROADWAY OPERATING CONDITIONS - AM PEAK HOUR
FIGURE A-9



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2030 WITH ALTERNATIVE PLAN ROADWAY OPERATING CONDITIONS - PM PEAK HOUR
FIGURE A-10

TRAFFIC SIMULATION MODEL DEVELOPMENT

The vehicle routing decisions along with the final future year (2030) origin-destination travel demand matrix contained in the VISUM traffic assignment models were transferred into VISSIM for the traffic operations analysis and determination of performance measures for future scenarios.

Overview of VISSIM Model Development

The development of the VISSIM model includes three basic components: (1) setup, (2) calibration, and (3) validation. The VISSIM model was constructed by drawing the roadway network using aerial photography as a background. The number of lanes and the location of lane additions and drops were confirmed by field observations. Additional detail was incorporated into the VISSIM network (posted speed limits, grades, etc.) to better reflect observed field conditions. Ramp meter signal operation (i.e., cycle lengths and timing plans) were specified. Driver behavior parameters were adjusted based on field observations. The distribution of vehicle types was also calibrated to local conditions so that the percentage of trucks and high-occupancy vehicles (HOVs) match the traffic counts.

Since micro-simulation models like VISSIM rely on the random arrival of vehicles, multiple runs are needed to provide a reasonable level of statistical accuracy and validity. Therefore, the results of 10 separate runs (each using a different random seed number) were averaged to determine the results.

The VISSIM model was calibrated to existing conditions using the criteria developed in *Applying Traffic Microsimulation Modeling Software* (Cambridge Systematics, 2002) and additional criteria developed by Fehr & Peers. A number of iterations were performed to successively adjust the default VISSIM parameters for geometrics and driver behavior until the model was validated to observed conditions.

The calibrated and validated model is used to generate performance measures that are consistent with *Highway Capacity Manual* (HCM) (Transportation Research Board, 2000). The validated VISSIM model will serve as the basis for future conditions models. The VISSIM model will be revised based on planned roadway improvements and forecasted traffic demand volumes. Then, the model will be run for 10 iterations using different random seeds, and the results checked for reasonableness. Finally, the performance measures for freeway mainline sections, ramp junctions, and travel time segments will be extracted.

Operations Model Input Data

The model setup required the input of geometric, traffic control, and traffic flow data as summarized below:

- Roadway geometric data were gathered using aerial photographs, design plans, and field observations. The lane configurations taken from aerial photographs were modified based on field observations.
- The posted speed limits for the freeways and ramps were collected during field observations.
- Existing traffic volumes in 15-minute intervals for the two-hour morning and four-hour afternoon peak periods: 6:00 to 8:00 AM and 2:30 to 6:30 PM. The peak hours are 6:30 to 7:30 AM and 5:00 to 6:00 PM.

- The traffic counts for the freeway mainline and most on- and off-ramps were collected using both manual and electronic methods in September 2008. Fehr & Peers estimated an origin-destination matrix using the exiting volume percentages for use in the traffic operations analysis model.
- Percentage of truck and HOV volumes in the general traffic was obtained from previous 2007 Traffic Count Data from HDOT. For this analysis, it was assumed that the truck and HOV vehicle (e.g., buses) percentage typically accounted for 5 percent of the general traffic and 6 percent of the general traffic on the H-1 Freeway.

Separate models were created for the AM and PM peak periods.

Operations Model Calibration

Adjustments to the VISSIM model focus on the model components related to driver behavior, driver performance, vehicle fleet mix, and vehicle performance. The following major VISSIM model parameters are subject to adjustment:

- Vehicle fleet composition (passenger cars, trucks and HOV vehicles such as transit or tour buses).
- Vehicle headways
- Distance between stopped vehicle (standstill distance)
- Driver behavior when changing lanes
- Driver behavior at ramp junctions (i.e., weaving sections, ramp merges etc.)

The VISSIM model was calibrated by replacing the default values with the values as shown in Table A-4.

TABLE A-4
TRAFFIC SIMULATION MODEL CALIBRATION ADJUSTMENTS

Category	Parameter	Default Value	Adjusted Value
Vehicle Fleet Composition	Car Percentage for Sedans	98%	95% (arterials); 96% (H-1 Freeway)
	Truck/HOV Percentage	2%	5% (arterials); 6% (H-1 freeway)
Lane Changing Behavior	Emergency Stop Distance	16 ft	50 ft
	Anticipatory Lane Change Distance	656 ft	1,500 ft
	Max. Look Ahead Distance	820.2 ft	1,500 ft
	Average Standstill Distance[1]	4.92 / 6.56 ft	4.92 / 6.56 ft
	Safety Distance Reduction Factor[2]	0.6	0.6, 0.2
	Max. deceleration for cooperative braking	-9.84 ft/s^2	-9.84 ft/s^2

Note:
1. The default average standstill distance varies for freeway (4.92 ft) and urban (6.56 ft) driving behavior models.
2. The default safety distance reduction factors varies for freeway during uncongested conditions (0.6) and congested conditions at merge section (0.2).

Source: Fehr & Peers, 2008

The default VISSIM input parameter values did not represent study area conditions. The calibrated values in Table A-4 represent field observations. For example, the default vehicle composition contains only standard sedans.

Operations Model Validation

The parameters affecting capacity were adjusted so that the observed traffic conditions (speed and queuing) were replicated in the VISSIM models. Table A-5 lists the adjustments made to the VISSIM model parameters at critical freeway merging and weaving locations as part of the validation process.

TABLE A-5
TRAFFIC SIMULATION MODEL CALIBRATION ADJUSTMENTS

Category	Parameter	Default Value	Adjusted Value(s)	
Freeway Mainline Capacity	Average Headway[1]	0.9 sec	AM	0.9, 1.64,1.8 sec
			PM	0.9, 1.64,1.8 sec
Freeway Lane Change Behavior	Anticipatory Lane Change Distance	2,000 ft	AM	2,000 – 4,000 ft
			PM	2,000 – 4,000 ft
Merge Area Capacity	Additive Part of Safety Distance	2.0	AM	0.9
			PM	0.9
	Multiplicative Part of Safety Distance	3.0	AM	1.4
			PM	1.4

Note: 1. VISSIM defines headway as the time between the rear bumper of the leading vehicle and front bumper of the following vehicle, unlike the HCM which uses the front bumper to front bumper time.
Source: Fehr & Peers, 2008

For both AM and PM peak periods, the lane change distance for many off-ramps on H-1 was increased to 2,000, 2,500, or 3,000 feet so that exiting vehicles changed lanes in time to reach an off-ramp or through vehicles. For the PM peak period, the average headway for the Nu'uanu Bridge area was increased to reflect the eastbound bottleneck caused by the merging traffic between Liliha on-ramp and Vineyard Boulevard on-ramp.

During validation, the VISSIM model output was compared against field data to determine if the output was within acceptable levels. Four validation criteria were used to calibrate the traffic conditions on the H-1 Freeway corridor and access ramps in the study area (3.95 mile), including:

- Average corridor travel times within 15 percent for more than 85 percent of cases
- Total volume over count ratio more than 85 percent
- Individual link speed have a visually acceptable speed-flow relationship
- Bottlenecks create visually acceptable queuing

Table A-6 shows the H-1 Freeway corridor travel time validation results that met the criteria. The speed-flow relationship and queuing at bottlenecks were visually inspected and found to be acceptable, consistent with the roadway utilization conditions shown in previous Figures A-3 and A-4 from the VISUM existing condition models.

TABLE A-6 H-1 FREEWAY CORRIDOR TRAVEL TIME VALIDATION							
		Field Measurement	VISSIM Model Travel Time			Speed (mph)	
Direction	Peak Hour	(min.:sec.)	Average (min.:sec.)	% Difference	Standard Deviation	Average	Standard Deviation
H-1 Westbound	AM	13:11	14:31	10%	0:40	16.4	0.8
5th to Nuuanu Bridge	PM	8:41	8:54	2%	2:09	28.1	5.4
H-1 Eastbound	AM	11:45	10:34	10%	0:25	22.5	0.9
Nuuanu Bridge to 5th St	PM	12:44	11:08	13%	0:55	21.4	1.8

Tables A-7 and A-8 present the validation results of the intersection volumes for the AM peak hour and PM peak hour, compared to estimated demand volumes subtracted from the VISUM model. The network summary indicated that the total model volumes over demand ratio exceeded the minimum criteria of 85 percent in both AM and PM VISSIM model.

TABLE A-6 ANALYZED INTERSECTION VOLUME VALIDATION RESULTS – AM PEAK HOUR					
		Demand	Volume Served		GEH
ID	Intersection	Volume	Average	%	
401	H-1 EB on-ramp & Kapiolani Blvd/Waiakamilo Road	1228	1001	81.5%	6.8
402	H-1 WB off-ramp & Kapiolani Blvd/Mahiai St	2553	2260	88.5%	6.0
403	H-1 EB Off Ramp & S King St	1418	1188	83.8%	6.4
41	H-1 EB on-ramp (departure) & King St/Kalialae Ave	1422	1526	107.3%	2.7
405	H-1 WB off-ramp & Kalihi Rd/Kalialae Ave	1452	1430	98.5%	0.6
407	H-1 EB on-ramp & Off Ramp & University Ave	2854	2481	86.9%	7.2
408	H-1 WB off-ramp & University Ave NB	3468	2984	86.0%	8.5
409	H-1 WB off-ramp & Dole St/Wilder Ave	1036	968	93.4%	2.1
411	H-1 WB on-ramp & Alexander St/Metcalf St	1512	757	50.1%	22.4
412	H-1 WB on-ramp & Punahou St (bridge)	2678	2692	100.5%	0.3
413	H-1 EB off-ramp & Punahou St (bridge) & Bingham St	2771	2395	86.4%	7.4
415	H-1 EB on-ramp & Pi'ikoi St	1600	1564	97.8%	0.9
417	Pensacola St & Lunalilo St	2586	2262	87.5%	6.6
418	H-1 EB on-ramp & Ward Ave/ Kinalau Pl	1694	1641	96.9%	1.3
419	H-1 EB off-ramp & Kinau St	1630	1168	71.7%	12.4
426	H-1 WB off-ramp (NB on University) and on-ramp (SB on	3559	2583	72.6%	17.6
427	Ward Ave & Kinau St	2999	2109	70.3%	17.6
428	Ward Ave & Lunalilo St	1726	1716	99.4%	0.2
429	Pi'ikoi St & Lunalilo St	1832	1596	87.1%	5.7
430	Ke'eaumoku St & Kinau St	1841	1601	87.0%	5.8
431	Ke'eaumoku St & Lunalilo St	1485	1365	91.9%	3.2
432	Pi'ikoi St & Kinau St	2153	1967	91.4%	4.1
433	Pensacola St & Kinau St	2159	1708	79.1%	10.3
500	Pensacola St & Wilder Ave	1439	1339	93.1%	2.7
501	Pi'ikoi St & Wilder Ave	1489	1351	90.7%	3.7
502	Ke'eaumoku St & Wilder Ave	2108	2086	99.0%	0.5
503	Punahou St & Wilder Ave	2951	3000	101.7%	0.9
504	McCully St & Dole St and Metcalf St	1956	1477	75.5%	11.6

(Continued) TABLE A-6
ANALYZED INTERSECTION VOLUME VALIDATION RESULTS – AM PEAK HOUR

ID	Intersection	Demand Volume	Volume Served		GEH
			Average	%	
505	University Ave & Dole St	3985	3439	86.3%	9.0
506	Punchbowl St & Vineyard Ave	5368	5059	94.2%	4.3
510	Punchbowl St & S. Beretania St	4595	3763	81.9%	12.9
511	Ward Ave & S. Beretania St	4431	3529	79.6%	14.3
512	Pensacola St & S. Beretania St	3892	3163	81.3%	12.3
513	Pi'ikoi St & S. Beretania St	3892	3381	86.9%	8.5
515	Kalakaua Ave & S. Beretania St	3159	2514	79.6%	12.1
516	McCully St & S. Beretania St	3526	2731	77.5%	14.2
518	Punchbowl St & S. King St	3694	3218	87.1%	8.1
521	Ward Ave & S. King St	2414	2109	87.4%	6.4
522	Pensacola St & S. King St	2803	2446	87.3%	7.0
523	Pi'ikoi St & S. King St	2880	2595	90.1%	5.4
525	Kalakaua Ave & S. King St	2941	2622	89.2%	6.0
526	McCully St & S. King St	2308	1985	86.0%	7.0
528	University Ave & Beretania St/King St	4303	3628	84.3%	10.7
531	Pensacola St & Kapiolani Blvd	2998	2700	90.1%	5.6
532	Pi'ikoi St & Kapiolani Blvd	3157	2919	92.5%	4.3
552	Punahou St & Beretania St	3706	3037	81.9%	11.5
547	Pi'ikoi St & Ala Moana Blvd	3632	3509	96.6%	2.1
534	Atkinson Dr & Kapiolani Blvd	3085	2660	86.2%	7.9
Network Summary					
Total Demand Volume (veh/hr)					128,367
Total Volume Served (veh/hr)					110,329
Percent Served					86%
Meet the 85% Criteria?					YES
GEH Statistic					52.2

EB: eastbound or Koko Head bound. WB: westbound (Ewa bound)

TABLE A-7
ANALYZED INTERSECTION VOLUME VALIDATION RESULTS – PM PEAK HOUR

ID	Intersection	Demand Volume	Volume Served		GEH
			Average	%	
401	H-1 EB on-ramp & Kapiolani Blvd/Waiaka Road	1613	1593	98.8%	0.5
402	H-1 WB off-ramp & Kapiolani Blvd/Mahiai St	2170	2336	107.6%	3.5
403	H-1 EB Off Ramp & S. King St	1820	1324	72.7%	12.5
41	H-1 EB on-ramp (departure) & King St/Waialae Ave	1083	804	74.2%	9.1
405	H-1 WB on-ramp & Kalele Rd/Waialae Ave	1025	1665	162.4%	17.5
407	H-1 EB on-ramp & Off Ramp at University Ave	2398	2421	101.0%	0.5
408	H-1 WB on-ramp & University Ave NB	2958	3115	105.3%	2.8
409	H-1 WB off-ramp & Dole St/Wilder Ave	1212	1389	114.6%	4.9
411	H-1 WB on-ramp & Alexander St/Metcalf St	1159	1035	89.3%	3.7
412	H-1 WB on-ramp & Punahou St (bridge)	2471	2514	101.7%	0.9
413	H-1 EB off-ramp & Punahou St (bridge) & Bingham St	2723	2477	91.0%	4.8
415	H-1 EB on-ramp & Pi'ikoi St	2393	1530	63.9%	19.5
417	Pensacola St & Lunalilo St	2707	2084	77.0%	12.7
418	H-1 EB on-ramp & Ward Ave/ Kinalau Pl	1962	1801	91.8%	3.7
419	H-1 EB off-ramp & Kinau St	1842	1611	87.5%	5.6
426	H-1 WB off-ramp (NB on University) and on-ramp (SB on	3036	2599	85.6%	8.2
427	Ward Ave & Kinau St	3571	2869	80.3%	12.4
428	Ward Ave & Lunalilo St	1706	1495	87.6%	5.3

(Continued) TABLE A-7
ANALYZED INTERSECTION VOLUME VALIDATION RESULTS – PM PEAK HOUR

ID	Intersection	Demand Volume	Volume Served		GEH
			Average	%	
429	Pi'ikoi St & Lunalilo St	2404	1631	67.8%	17.2
430	Ke'eaumoku St & Kinau St	2645	2029	76.7%	12.7
431	Ke'eaumoku St & Lunalilo St	2130	1648	77.4%	11.1
432	Pi'ikoi St & Kinau St	3250	1957	60.2%	25.3
433	Pensacola St & Kinau St	2322	1975	85.1%	7.5
500	Pensacola St & Wilder Ave	1358	1339	98.6%	0.5
501	Pi'ikoi St & Wilder Ave	1683	1428	84.8%	6.5
502	Ke'eaumoku St & Wilder Ave	2617	2325	88.8%	5.9
503	Punahou St & Wilder Ave	2754	2408	87.4%	6.8
504	McCully St & Dole St and Metcalf St	4019	1660	41.3%	44.3
505	University Ave & Dole St	3405	3450	101.3%	0.8
506	Punchbowl St & Vinyard Ave	4145	4031	97.2%	1.8
510	Punchbowl St & S. Beretania St	5073	4818	95.0%	3.6
511	Ward Ave & S. Beretania St	3895	3357	86.2%	8.9
512	Pensacola St & S. Beretania St	3381	2927	86.6%	8.1
513	Pi'ikoi St & S. Beretania St	4285	3052	71.2%	20.4
515	Kalakaua Ave & S. Beretania St	2621	2427	92.6%	3.9
516	McCully St & S. Beretania St	2891	2679	92.7%	4.0
518	Punchbowl St & S. King St	3942	3803	96.5%	2.2
521	Ward Ave & S. King St	[illegible]	[illegible]	5.0%	10.7
522	Pensacola St & S. King St	[illegible]081	3334	81.7%	12.3
523	Pi'ikoi St & S. King St	[illegible]658	3507	75.3%	18.0
525	Kalakaua Ave & S. King St	[illegible]	2349	87.0%	7.0
526	McCully St & S. King St	[illegible]334	2349	89.2%	5.7
528	University Ave & Beretania St & King St	[illegible]557	4518	99.1%	0.6
531	Pensacola St & Kapiolani Blvd	[illegible]144	3211	93.2%	4.0
532	Pi'ikoi St & Kapiolani Blvd	[illegible]722	3323	89.3%	6.7
552	Punahou St & Beretania St	3778	3172	84.0%	10.3
547	Pi'ikoi St & Ala Moana Blvd	8317	5621	67.6%	32.3
534	Atkinson Dr & Kapiolani Blvd	3780	3338	88.4%	7.4

Network Summary	
Total Demand Volume (veh/hr)	143,080
Total Volume Served (veh/hr)	122,360
Percent Served	86%
Meet the 85% criteria?	YES
GEH Statistic	56.9

EB: eastbound or Koko Head bound. WB: westbound (Ewa bound)

Like the development of future VISUM traffic forecasting model, the validated existing VISSIM simulation models were modified to include future baseline roadway improvements assumed in the 2030 O'ahuMPO model for 2030 baseline conditions first. Necessary changes to the signal operations and driver behaviors were made to reflect future traffic flow patterns. The finished 2030 baseline models were then adapted to include regional roadway improvements and local station area circulation improvements proposed in the Recommended Roadway Improvements Plan and the Alternative Roadway Improvements, as described in Chapter 6 of *Kaka'ako Areawide Traffic Study*.

Several performance measures were used to develop the proposed roadway improvements and the alternative plan, as described in the Existing and Future Base conditions analysis (Chapters 4

and 5) as well as the assessment of the Recommended Plan (Chapter 6) in *Kaka'ako Areawide Traffic Study*. These measures were output from the VISSIM models, including corridor travel time, number of vehicles served, vehicle miles traveled (VMT), vehicle hours traveled (VHT), vehicle hours of delay (VHD), speed, and vehicle hours of delay per mile, freeway ramp and intersection level of service (LOS).

STATION AREA INTERSECTION LEVEL OF SERVICE ANALYSIS

Intersection operating conditions adjacent to the proposed three guideway stations were analyzed using the same tool and methodology as described in the Transportation Technical Report (Section 2.3.3) of the DEIS. Future 2030 turning movement forecasts were developed for the intersections surrounding the proposed guideway stations, following the same methodology used in the DEIS.

This methodology defines intersection operating LOS conditions based on the average vehicle control delay for signalized intersections and longest delay experienced by any single movement for intersections controlled by stop signs. LOS definitions are provided in Table A-9 for signalized intersections and Table A-10 for unsignalized intersections.

TABLE A-9
LEVEL OF SERVICE DEFINITIONS FOR SIGNALIZED INTERSECTIONS

Level of Service	Control Delay (seconds/vehicle)	Interpretation*
A	≤10.0	This level of service occurs when progression is extremely favorable and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.
B	>10.0 and ≤20.0	This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop than with LOS A, causing higher levels of average delay.
C	>20.0 and ≤35.0	These higher delays may result from fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping.
D	>35.0 and ≤55.0	At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high volume-to-capacity ratios. Many vehicle stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.
E	>55.0 and ≤80.0	This level is considered by many agencies to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high volume-to-capacity ratios. Individual cycle failures are frequent occurrences.
F	>80.0	This level, considered unacceptable by most drivers, often occurs with oversaturation; that is, when arrivals flow rates exceed the capacity of the intersection. It may also occur at high volume-to-capacity ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Source: *Highway Capacity Manual*, Transportation Research Board, 2000.
*Level of service interpretation was derived from *Highway Capacity Manual 1994*, Transportation Research Board, 1994.

TABLE A-10
LEVEL OF SERVICE DEFINITIONS FOR STOP-CONTROLLED INTERSECTIONS

Level of Service	Control Delay (seconds/vehicle)
A	≤10.0
B	>10.0 and ≤15.0
C	>15.0 and ≤25.0
D	>25.0 and ≤35.0
E	>35.0 and ≤50.0
F	>50.0

Source: *Highway Capacity Manual*, Transportation Research Board, 2000.

EFFECT OF PI'IKOI-PENSACOLA REVERSAL

The ORTP 2030 has proposed to reverse the direction of the existing one-way Pi'ikoi Street and Pensacola Street (Project No. 53). During the development of the future 2030 baseline traffic forecasts and simulation models for the Kaka'ako Areawide Traffic Study, it was found that the proposed reversal in operations may significantly affect the travel patterns in the study area, which would not provide a fair evaluation of the benefits and effects of the Recommended Roadway Improvement Plan or the Alternative Plan.

Reversal of operations on Pi'ikoi Street and Pensacola Street would significantly impact the regional access to the Kaka'ako and Makiki neighborhoods to the H-1 Freeway. The following traffic shifts may occur due to the reversal of the one-way couplet:

- Under current conditions, traffic from the makai side of the H-1 Freeway can utilize the mauka bound triple left-turn lanes at Pi'ikoi Street and Lunalilo Street and then diverge to the Lunalilo on-ramp or Lunalilo Street frontage road. Due to the proximity of Pensacola Street and the Lunalilo on-ramp, conversion of Pensacola Street from makai bound to mauka bound would limit the left-turn volumes from Pensacola Street to Lunalio on-ramp.

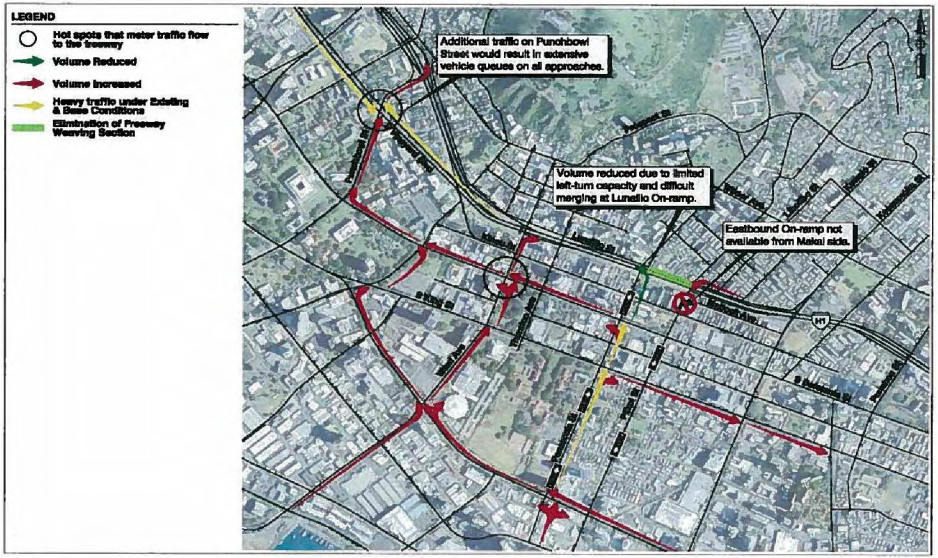
- Traffic intending to use the H-1 Freeway to Aiea or further west would likely change course to use Beretania Street or Kapiolani Boulevard to access the westbound on-ramp at Punchbowl Street. Because the intersection of Vineyard Boulevard and Punchbowl Street has been heavily utilized under existing conditions and would remain congested under future 2030 conditions, additional traffic on Punchbowl Street would create much worse congestion on all approaches, with extended queues and stop-and-go conditions on Vineyard Boulevard, Beretania Street, Ward Avenue, and Kapiolani Boulevard.

- Conversion of Pi'ikoi Street from makai bound to mauka bound would result in a change in access to the eastbound on-ramp at Pi'ikoi Street just makai of the H-1 freeway. This eastbound on-ramp would more likely be utilized by the communities in the Makiki area or Punahou area.

- Traffic from the Kaka'ako or the Ala Moana communities would no longer have easy access to the H-1 eastbound on-ramp via Pi'ikoi Street makai of the H-1 Freeway. This traffic would more likely use the other eastbound on-ramp at Ward Avenue or University Avenue. However, because these two ramps are heavily utilized under existing conditions and would remain heavily utilized in future conditions, this traffic may choose to stay on an eastbound arterial such as King Street, Kapiolani Boulevard or Ala Moana Boulevard.

Compared to the 2030 No Build Conditions without this ORTP project, 2030 conditions with this ORTP project would likely result in less traffic on the H-1 Freeway between the Punchbowl Street on-ramp and Lunalilo on-ramp because traffic may re-route to other parallel arterials. These traffic shifts would increase the critical movements at high-volume intersections such as Vineyard Boulevard at Punchbowl Street and Beretania Street at Ward Avenue, creating major bottlenecks and metering local traffic entering the H-1 Freeway. This traffic shift phenomenon would be much more visible in the PM peak period when the Lunalilo on-ramp to the H-1 Freeway would remain open and the Ewa-bound travel on the H-1 Freeway would be generally more desired in the PM peak period in terms of the overall commute patterns.

The goal of the Recommended Plan as described in Chapter 6 of *Kaka'ako Traffic Study* is to improve H-1 Freeway access to and from the Kaka'ako-Makiki area and future guideway stations as well as enhance the traffic operations on the H-1 Freeway. Inclusion of the proposed roadway reversal project from the ORTP would create a baseline scenario significantly different from the existing conditions and may impact the assessment of the effects of the recommended reconfiguration for the Vineyard off-ramp and the Lunalilo on-ramp and adjacent arterials. Therefore, the ORTP project assuming the direction of the Ala Moana-Pi'ikoi Couplet was not assumed in the analysis of the 2030 baseline for the Kaka'ako Traffic Study.



FEHR & PEERS
TRANSPORTATION CONSULTANTS

REVERSAL OF PIIKOI-PENSACOLA STREET ONE-WAY COUPLET
FIGURE A-11

APPENDIX B:
EVALUATION OF PIIKOI/PENSACOLA REVERSAL OF ONE-WAY COUPLET
SUMMARY OF RESULTS
(FEHR & PEERS, JULY 2009)

DRAFT

EVALUATION OF PIIKOI/PENSACOLA REVERSAL OF ONE-WAY COUPLET
SUMMARY OF RESULTS

The OMPO recommendation to reverse traffic directions on Piikoi and Pensacola Streets has been examined in conjunction with the overall analysis of the ongoing closure of the Lunalilo Street on-ramp to the H-1 Freeway and other issues associated with the Kakaako Area rapid transit traffic analysis. It has been determined that this proposed highway improvement does not achieve its objective of improving traffic operations within the study area for a variety of reasons. The analysis indicates that this recommendation would have negative effects both directly on the one-way pair of streets and, more significantly, indirectly on other major roadways in the study area. Simply stated, it would increase the existing congestion at the Beretania Street at Ward Avenue intersection and at the Vineyard Boulevard at Punchbowl Street intersection, resulting in a complete breakdown of local circulation in and around the Kaka'ako study area.

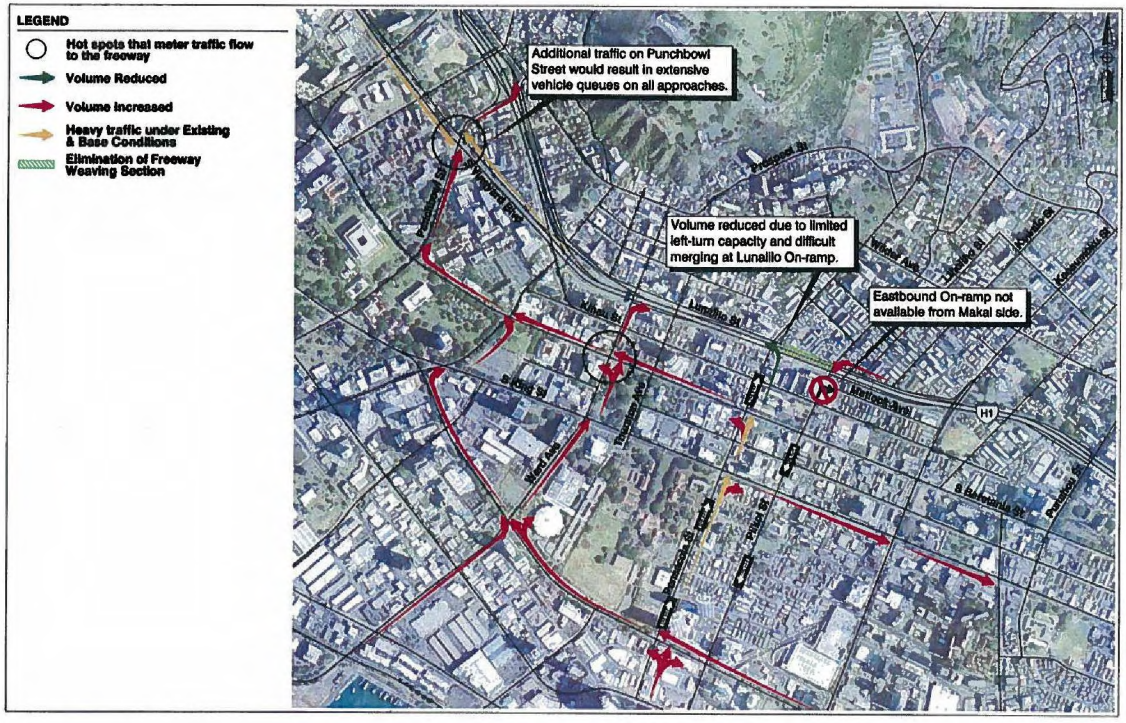
INDIRECT IMPACTS

Under existing conditions, the three northbound left-turn lanes on Piikoi Street at the Lunalilo Street intersection are unable to accommodate the peak period traffic demand, especially during the evening peak period. The majority of these vehicles are attempting to access and utilize the Lunalilo Street on-ramp to head ewa-bound on H-1. Vehicle queues frequently extend past King Street because of the high traffic demand that is attempting to access H-1 using the Piikoi Street connection to Ala Moana Boulevard and the Ala Moana Center, coupled with the limited capacity of the single-lane Lunalilo Street on-ramp. If the traffic directions on Piikoi and Pensacola Streets were reversed, the capacity of this connection from H-1 to Ala Moana Boulevard and the Ala Moana Center would be significantly reduced, forcing many of these vehicles to find alternative routes to H-1. While Pensacola Street does remain the primary option, it could only operate as a single northbound left-turn lane at the Pensacola Street at Lunalilo Street intersection because of the proximity of the single-lane Lunalilo Street on-ramp. If more than one lane of traffic was allowed to turn left from Pensacola onto Lunalilo, there would be insufficient room for the vehicles attempting to use the on-ramp in the second and third lanes to merge into the single lane on-ramp.

The result would be that vehicles would be forced to utilize the H-1 westbound on-ramp at Punchbowl Street since a northbound left-turn is not allowed at the H-1 westbound on-ramp at Punahou Street. The travel demand model indicates this overflow traffic would travel mauka from Ala Moana on an extremely congested Ward Avenue, Alapai Street and Pensacola Street to make a left-turn onto an already congested Beretania Street in order to access the H-1 ewa-bound on-ramp at Punchbowl Street. This would result in a large increase in northbound through traffic at the Punchbowl Street at Vineyard Boulevard intersection, which already experiences extremely heavy eastbound and westbound traffic heading to and from H-1 along Vineyard Boulevard. The traffic analysis indicates that vehicles passing through either the Beretania Street at Ward Avenue or the Vineyard Boulevard at Punchbowl Street intersections would experience extreme delays resulting in a total breakdown of the local circulation system.

DIRECT IMPACTS

The reversal of traffic directions on Piikoi and Pensacola Streets would totally reduce the effectiveness of the H-1 eastbound on-ramp at Piikoi Street, even if two-way operations were allowed on Piikoi Street near H-1. The revised operation of the street system would reduce the ability of this ramp to accommodate much of the diamondhead-bound traffic forcing traffic in the Kaka'ako and Ala Moana areas to further utilize Ward Avenue since the next closest eastbound on-ramp is located at University Avenue. As discussed above, Ward Avenue is a congested facility that would become more so with this added traffic. Also, the need to use Ward Avenue to access H-1 in this direction would force some of the traffic to backtrack, i.e., travel in the ewa direction first to access the freeway in the diamondhead direction.



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REVERSAL OF PIIKOI-PENSACOLA STREET ONE-WAY COUPLET

Administrative Draft Executive Summary
Kaka'ako Areawide Traffic Study

Submitted to:

City and County of Honolulu

Submitted by:

FEHR & PEERS
201 Santa Monica Blvd. Suite 500
Santa Monica, CA 90401

FEHR & PEERS
TRANSPORTATION CONSULTANTS

PB PARSONS BRINCKERHOFF

PURPOSE OF THE STUDY

With the anticipated construction of the proposed Honolulu High Capacity Transit Corridor Project (HHCTCP), the proposed Kaka'ako Station will provide opportunities for developing an integrated multi-modal environment and transit-oriented development for the Kaka'ako-Makiki communities and Ward neighborhoods. The area surrounding the proposed Kaka'ako station has a high level of urban density with a mix of apartment and commercial properties. However, existing traffic congestion on the regional H-1 freeway and major arterials has significantly affected the quality of life of the Kaka'ako communities and impedes multi-modal access to the proposed guideway transit stations in the study area, including Kaka'ako Station, Civic Center Station, and Ala Moana Station.

The Kaka'ako Areawide Traffic study was conducted to identify the regional freeway bottlenecks and causes of local traffic congestion in the study area and presents an areawide transportation improvement program that aids mobility. A key element of the study is the operations of the H-1 Freeway. The goals of the Kaka'ako Study include:

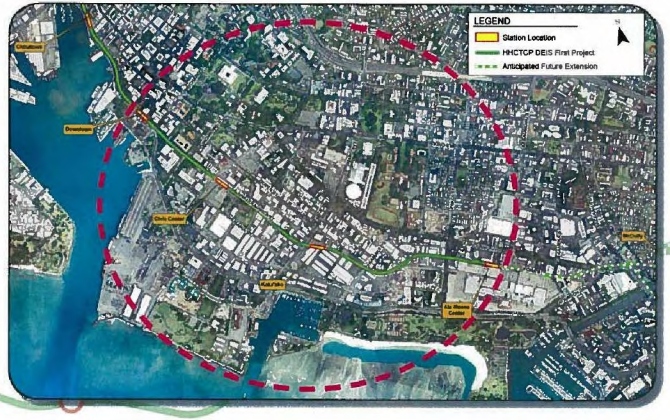
- To detail and quantify the potential traffic implications associated with the alignment and station area activity of the HHCTC as discussed and mitigated in the Draft Environmental Impact Statement (DEIS)
- To assess the need for additional local access and circulation system improvements in and around the high-density commercial and residential development in the Kaka'ako study area as a result of traffic from the HHCTC stations and other area projects
- To evaluate the regional access to the high-density commercial and residential development in the study area and identify additional highway improvements or modifications to aid mobility in response to traffic generated in the vicinity of the HHCTC stations and other area projects

PROJECT STUDY AREA

The study area encompasses the H-1 freeway from Pali Highway to just east of Kapahulu Avenue (approximately four miles). For local circulation, the study boundary is defined by Wilder Avenue and Lunalilo Street on the north, Punchbowl Street on the west, Ala Wai Canal and Kapi'olani Boulevard on the east, and the Pacific Ocean. The area currently supports roughly 7,000 residents and 23,400 jobs.

Between year 2000 and 2030, the study area is envisioned for a significant change in land use makeup from primarily industrial and commercial uses to a high-density residential and commercial mix. The population and employment are expected to increase considerably to almost 33,000 residents and 33,800 jobs.

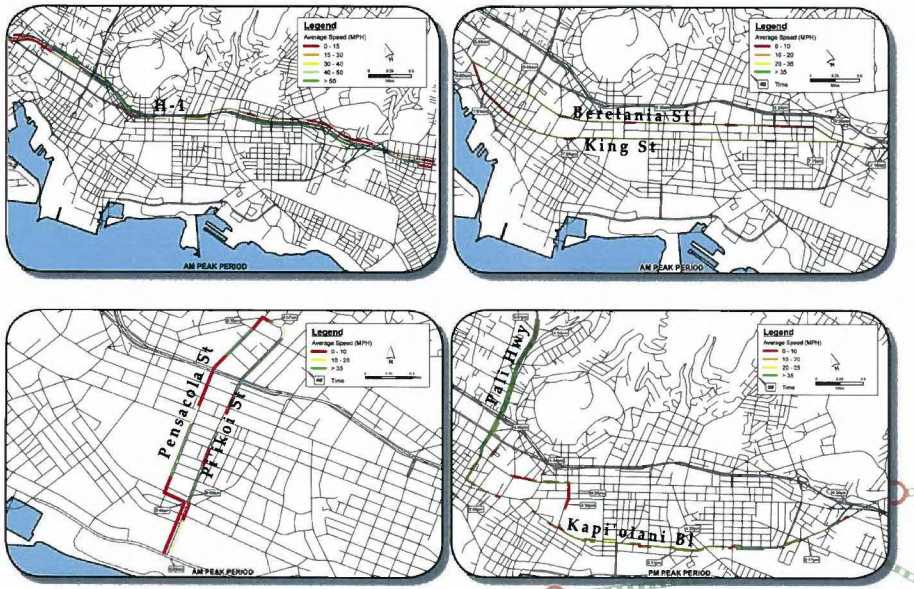
Existing traffic congestion on the regional H-1 freeway and major arterials has significantly affected the circulation and quality of life of residents and visitors in the study area. Severe congestion at the freeway interchanges with gridlock conditions were observed at all ramp access intersections, resulting in increased neighborhood cut-through traffic.



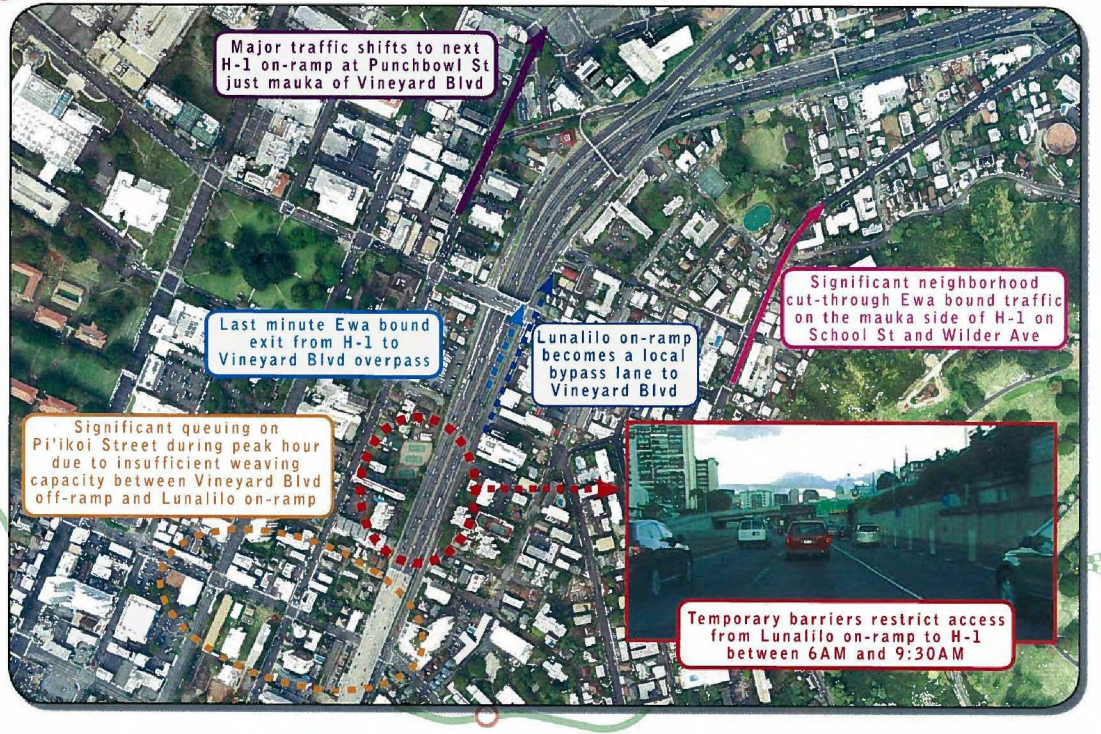
STUDY APPROACH FOR THE KAKA'AKO STUDY

- DATA COLLECTION
  - Traffic Volumes
  - Travel Time Runs
- DEVELOP EXISTING CONDITIONS AND TRAFFIC MODELS
- IDENTIFY CONGESTED AREAS AND DETERMINE CAUSES
- FORM LIST OF POTENTIAL IMPROVEMENTS
- USE MODEL TO EVALUATE POTENTIAL IMPROVEMENTS
- ASSESS ANALYTICAL RESULTS
  - Travel Time
  - Total Traffic Volume Served
  - Total Vehicle Hours Traveled
- RECOMMENDATIONS
  - Identify Preferred Alternatives
  - Provide Cost Estimate

TRAVEL TIME AND SPEED SURVEYS TO IDENTIFY HOT SPOTS



MAJOR BOTTLENECK AREAS DUE TO RESTRICTED ACCESS FROM LUNALILO ON-RAMP TO H-1

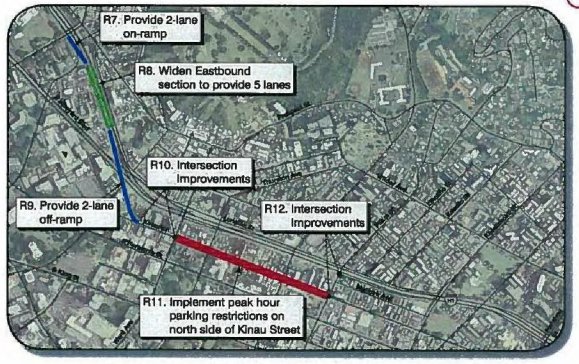


RECOMMENDED ROADWAY IMPROVEMENT PROGRAM

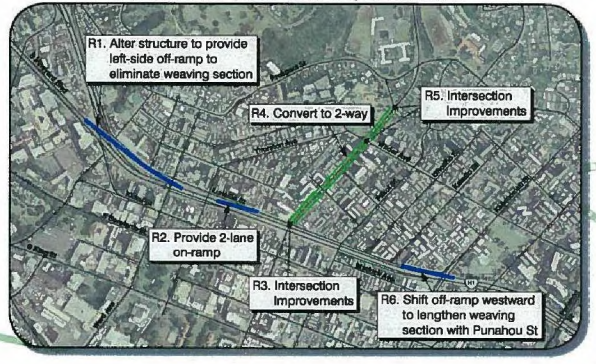
The plan recommends 20 roadway improvement projects in the contexts of both regional access (12 projects) and local circulation near future guideway stations (8 projects). Highlights of the plan are:

- Add a new left-hand off-ramp from H-1 to Vineyard Boulevard, with reconfiguration to existing Vineyard Boulevard flyover (R1)
- Re-open access from the Lunalilo on-ramp to the H-1 Freeway during the AM peak period, and provision of two lanes on the Lunalilo Street on-ramp that would merge into a single lane before merging with H-1 after the Vineyard Boulevard off-ramp (R2)
- Widen the H-1 eastbound mainline from the Pali Highway on-ramp to the Kinau Street off-ramp by one lane to allow two lanes entering from Pali Highway to H-1 (R7 & R8)
- Widen H-1 eastbound off-ramp at Kinau Street from one to two lanes (R9)
- Shift H-1 westbound off-ramp at Lunalilo Street to lengthen the weaving section with Punahou Street (R6)
- Peak hour parking restriction on one side of Kinau Street between Ward Avenue and Pi'ikoi Street for additional eastbound travel lane (R10 & R11)
- Convert Pensacola Street mauka of Lunalilo Street to just north of Wilder Avenue to two-way operations (with one lane northbound and two lanes southbound) (R4)
- Improve access to H-1 Freeway ramps by modifying lane geometry at three intersections: Lunalilo Street/Pensacola Street, Pi'ikoi Street/Kinau Street/Lunalilo Street, Pensacola Street/Wilder Avenue/Pi'ikoi Street (R3, R5 & R12)
- New circulation roadways near the future Kaka'ako guideway transit station and the Ward neighborhood (L1)
- Improve access to future guideway station area by modifying lane geometry and/or control devices at these intersections: Ward Avenue/ Ala Moana, Ward Avenue/Queen Street, Kamakee Street/Ala Moana Boulevard, Cooke Street/Halekauwila Street, Kona Street/Ke'eaumoku Street, Kona Street/ Kaheka Street, Kapi'olani Boulevard/Ward Avenue (L2-L8)

Eastbound (Koko Head Bound)Direction

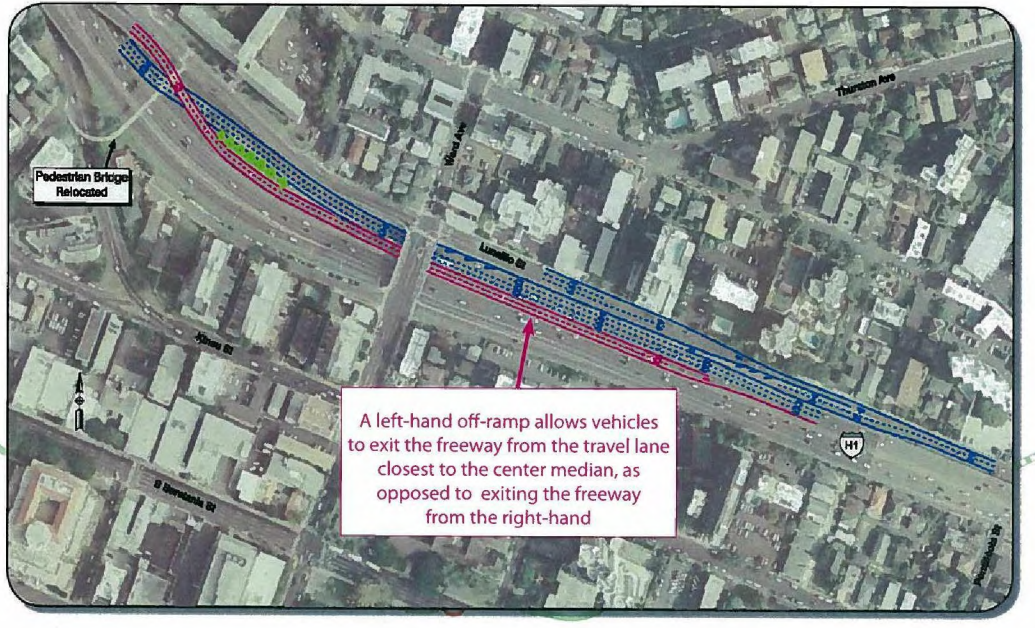


Eastbound (Ewa Bound)Direction

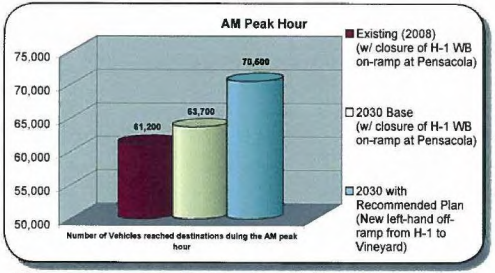


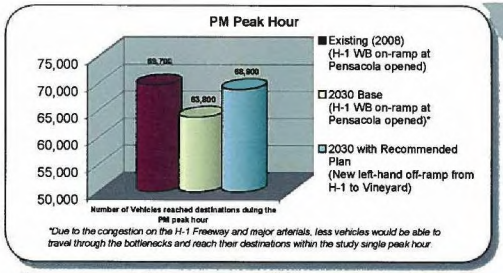
Conceptual Design for the H-1 Vineyard Interchange:

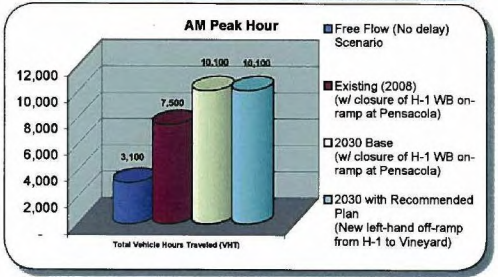
- Add a new left-hand off-ramp from H-1 to Vineyard Boulevard, with reconfiguration to existing Vineyard Boulevard flyover
- Resume access to H-1 Lunalilo on-ramp and eliminate traffic weaving between Lunalilo on-ramp and Vineyard off-ramp
- Reduce traffic queuing along Lunalilo Street, Pi'ikoi-Pensacola Couplet

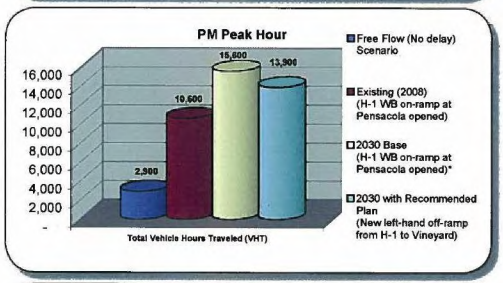


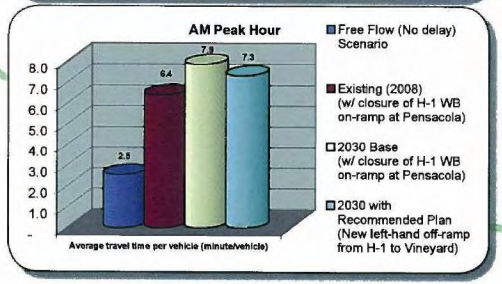
RECOMMENDED PLAN WOULD REDUCE AVERAGE TRAVEL TIME

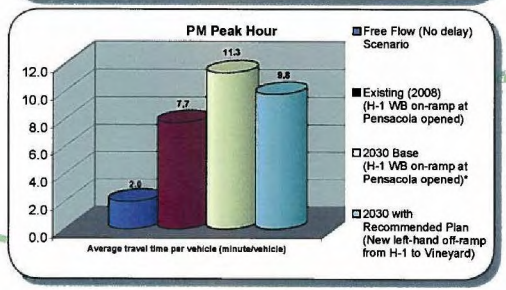




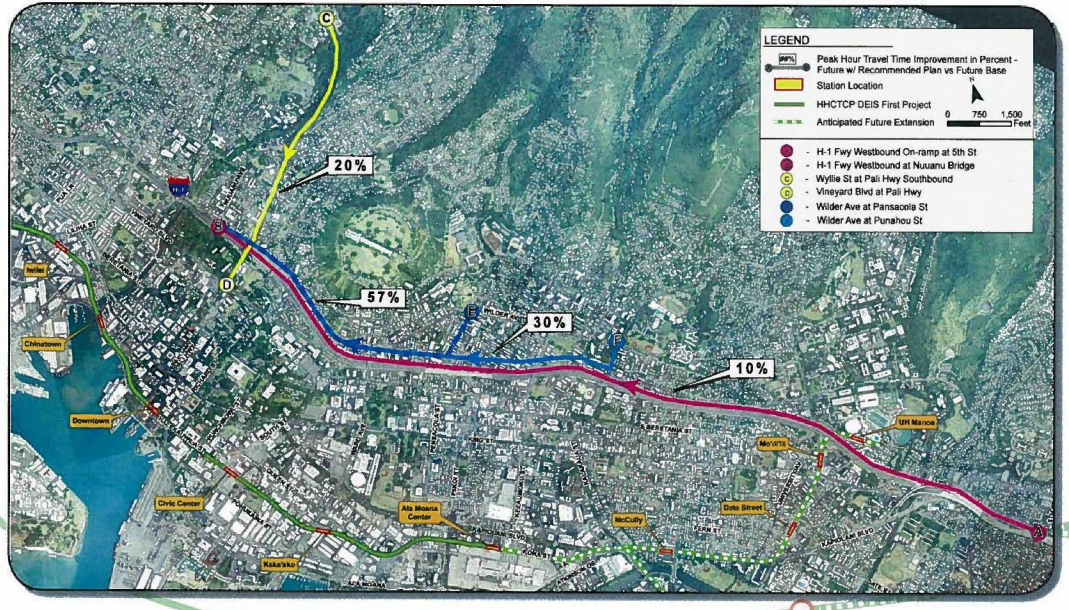




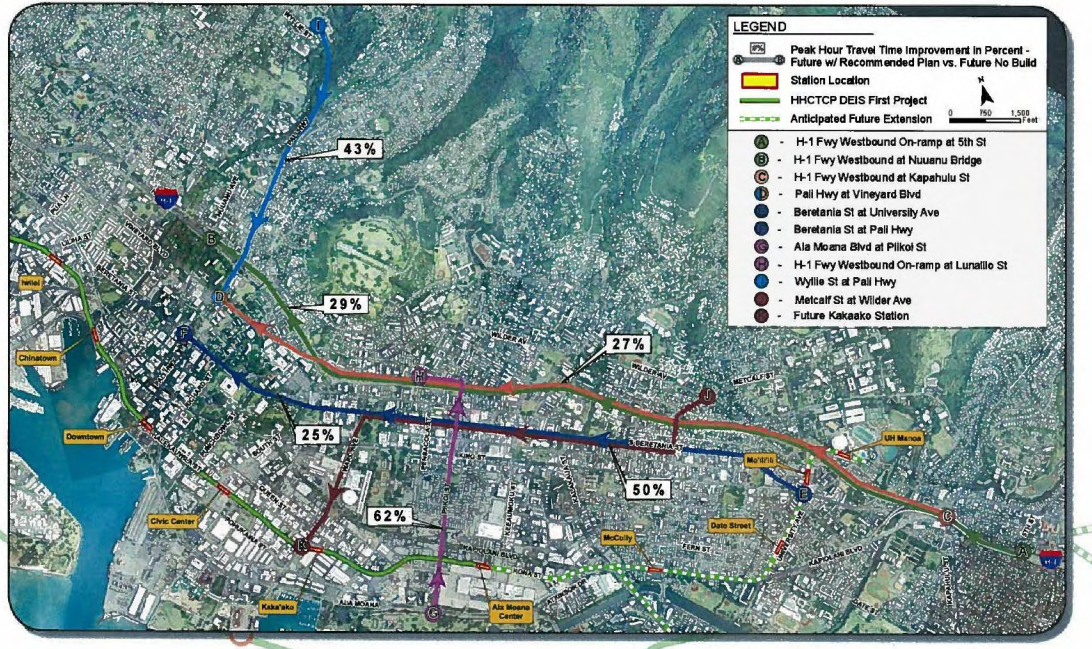




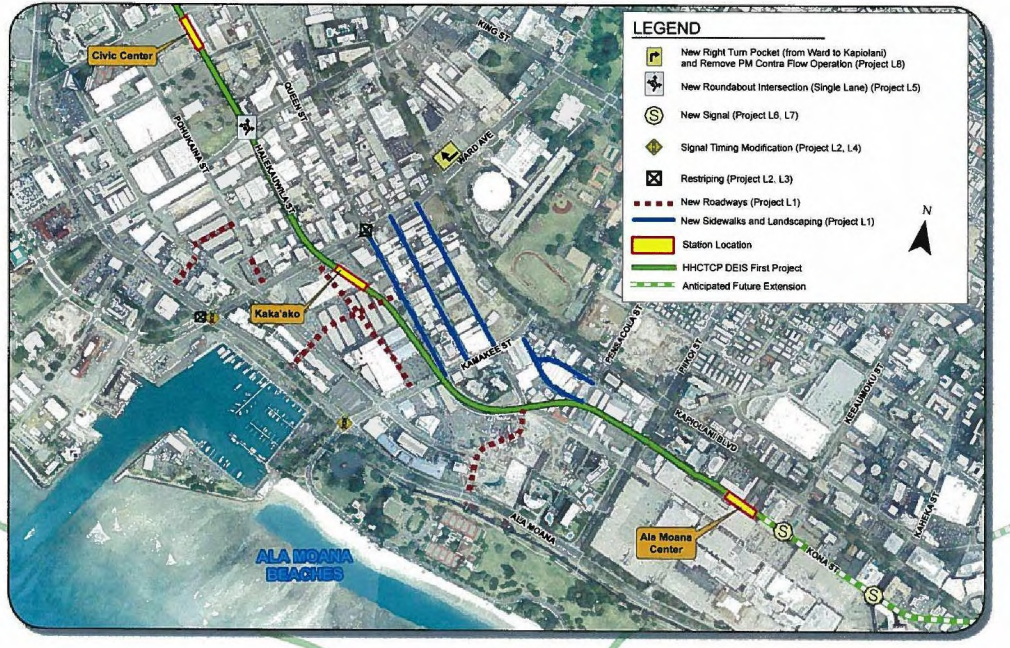
AM PEAK HOUR TRAVEL TIME DECREASE WITH RECOMMENDED PLANS (% CHANGE)



PM PEAK HOUR TRAVEL TIME DECREASE WITH RECOMMENDED PLAN (% CHANGE)



RECOMMENDED LOCAL IMPROVEMENTS NEAR FUTURE RAIL STATIONS



SUMMARY OF SYSTEMWIDE BENEFITS

- Carry additional 7,000 (AM) and 5,000 (PM) vehicles to their destinations in the study area and other communities on the island (rather than facing delays on congested freeway or local roadways)
- Reduce systemwide VEHICLE HOURS OF DELAY up to 10% in the peak hour
- Reduce average VEHICLE TRIP TRAVEL TIME up to 17% in the peak hour
- Save up to 8 minutes for traffic from UH Manoa to the City Hall via H-1 Freeway
- Save up to 5 minutes to/from Kaka'ako rail station to the Makiki communities

PROGRAM COST ($239 million)

- $119 million for the H-1/Vineyard Interchange Improvement
- $120 million for other 19 regional and local improvements
- Right-of-Way acquisition not included